DOE/OR/07-2027&D1
Secondary Document

C-746-S&T Landfills Remedial Investigation Scoping Document at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

July 2002

CLEARED FOR PUBLIC RELEASE

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

DOE/OR/07-2027&D1
Secondary Document

C-746-S&T Landfills Remedial Investigation Scoping Document at the Paducah Gaseous Diffusion Plant Paducah, Kentucky

Date Issued—July 2002

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

by
Bechtel Jacobs Company LLC
managing the

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-98OR22700

02-083(doc)/071202

CONTENTS

FIGURES

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

ABBREVIATIONS AND ACRONYMS

ACO	Administrative Consent Order
AOC	Area of Concern
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FFA	Federal Facility Agreement
FS	feasibility study
GWOU	Groundwater Operable Unit
HU	hydrologic unit
KAR	Kentucky Administrative Regulation
KDEP	Kentucky Department for Environmental Protection
LCD	Lower Continental Deposits
MCL	maximum contaminant level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NSDD	North-South Diversion Ditch
OREIS	Oak Ridge Environmental Information System
PAH	polyaromatic hydrocarbons
PCB	polychlorinated biphenyl
PCOC	potential contaminant of concern
PCT	Project Core Team
PGDP	Paducah Gaseous Diffusion Plant
pH	negative logarithm of the hydrogen ion concentration
ppm	parts per million
RAO	Remedial Action Objective
RBC	risk-based concentration
RFI	RCRA Facility Investigation
RGA	Regional Gravel Aquifer
RI	remedial investigation
SAP	Sampling and Analysis Plan
SSL	site-specific limit
SWMU	Solid Waste Management Unit
^{99}Tc	technetium-99
TCE	trichloroethene
U	uranium
UCD	Upper Continental Deposits
UCRS	Upper Continental Recharge System
VOC	volatile organic compound
WAG	waste area group

THIS PAGE INTENTIONALLY LEFT BLANK

1. INTRODUCTION

This scoping document has been prepared to assist in the development of the Remedial Investigation/ Feasibility Study (RI/FS) Work Plan outlining the investigation and possible subsequent remediation of the C-746-S&T Landfills at the Paducah Gaseous Diffusion Plant (PGDP) and of contiguous areas to the east, south, and west of these landfills. These landfills are located on U.S. Department of Energy (DOE) property, outside the secured area, and north of PGDP and Ogden Landing Road. The RI study area is shown on Fig. 1.1. The purpose of the RI/FS process is to identify, investigate, and assess potential risks to human health and the environment. The FS process also identifies and evaluates remedies that eliminate, reduce, or control identified risks to human health and the environment, while minimizing the amounts of contamination left without treatment. This purpose is consistent with §300.430 of the National Contingency Plan (NCP). Also consistent with the NCP (§300.415), should such conditions be found, a removal action may be proposed and completed.

The primary objectives of the C-746-S&T Landfills RI/FS are to collect adequate data to assess risk to human health and the environment; to determine if a risk is present; and to evaluate and select remedial and/or removal actions protective of human health and the environment for any risks determined to be present from the solid waste management units (SWMUs) within the investigation area. Based on process knowledge and historical data, it is expected that any contamination associated with the SWMUs included in this study area will pose no immediate threat because contamination will be confined to locations where exposure to industrial workers is unlikely. The DOE is committed to defining the full nature and extent of contamination within the study area and to evaluating fate and transport processes that could result in an impact to other receptors (i.e., recreational users and local residents) via off-site migration.

The study area to be addressed in this RI includes the following potential source areas (Fig. 1.1):

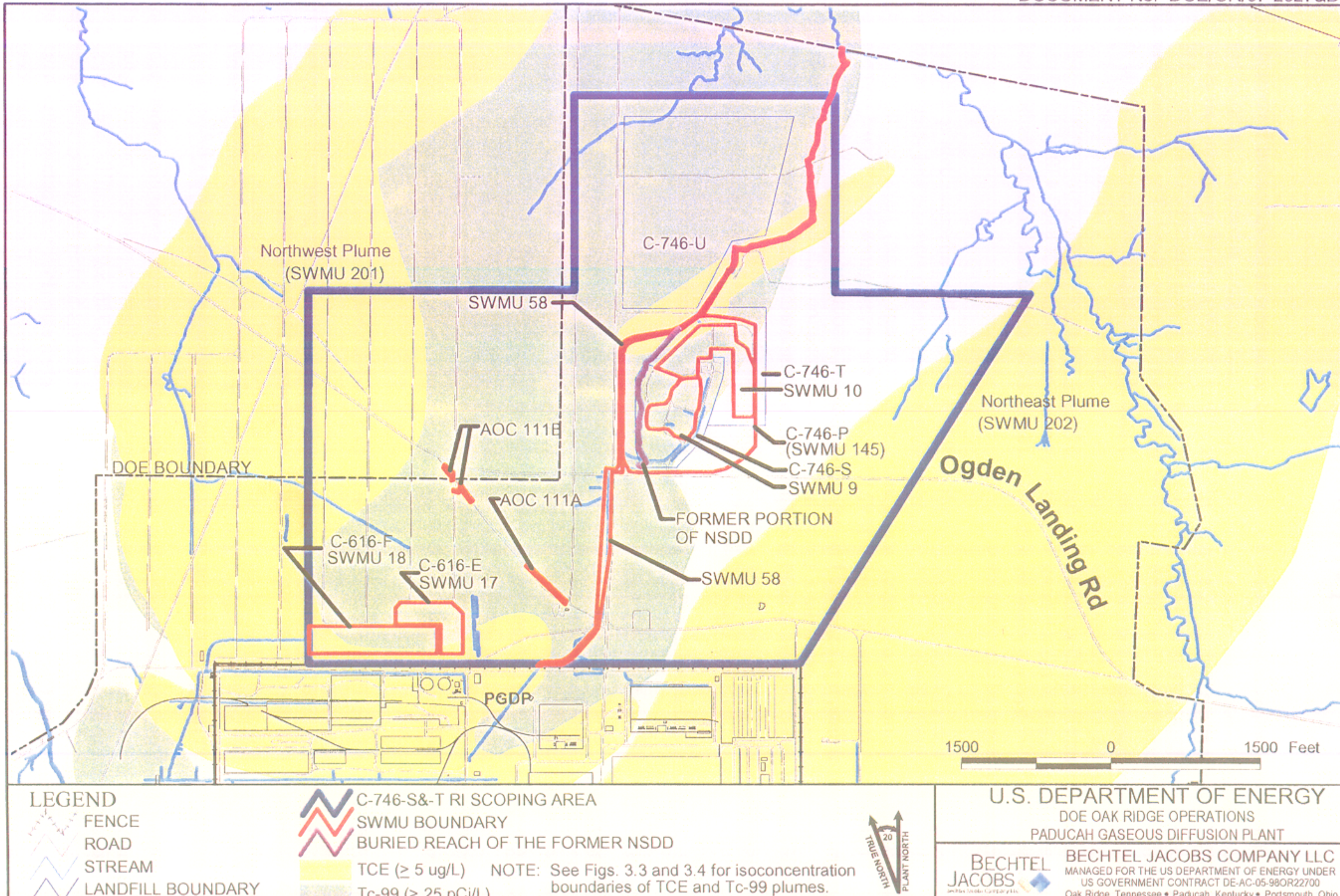
- SWMUs 9 and 10 - the C-746-S&T Landfills, respectively;
- SWMUs 17 and 18 - the C-616-E and -F Lagoons, respectively;
- a portion of SWMU 58 - the North-South Diversion Ditch (NSDD) outside the PGDP security area;
- the buried section of the former NSDD;
- Area of Concern (AOC) 111 (A and B) - Concrete Rubble Piles 9A and 9B;
- SWMU 145 - the Construction/Demolition Debris Disposal and Spoils Area (C-746-P);
- portions of SWMU 201 - the Northwest Plume; and
- portions of SWMU 202 - the Northeast Plume.

1.1 CONSISTENCY WITH THE FEDERAL FACILITY AGREEMENT

This document is organized according to the outline for scoping documents presented in the Federal Facility Agreement (FFA) for the PGDP, Appendix D (February 13, 1998). The FFA notes that the elements included in its outline "shall be considered and incorporated, as appropriate, when developing the (scoping document)." Table 1.1 presents a crosswalk relating each section of this scoping document to the corresponding section specified in the outline for scoping documents set forth in the FFA.

This scoping document uses the data quality objectives (DQOs) process as a planning tool to assist in the identification of environmental problems and to define the data collection processes needed to support decisions regarding the environmental problems associated with the C-746-S&T Landfills and contiguous areas. The decision rules and data needs identified during DQO meetings held in November and December of 2001 with the Groundwater Operable Unit (GWOU) Project Core Team (PCT) are detailed in Chap. 6 of this document. One purpose of this document is to assist the stakeholders in the finalization of these decision

DOCUMENT No. DOE/OR/07-2027&D1



U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 1.1. SWMUs within C-746-S&T RI scoping area.

FIGURE No. c5ac90001sk094r3.apr
DATE 07-10-02

Table 1.1. Crosswalk between C-746-S&T Landfills RI/FS Scoping Document and the FFA Scoping Document requirements

Scoping Document Section	FFA Requirement
1. Introduction 1.1 Consistency With the Federal Facility Agreement 1.2 Purpose and Goals of the C-746-S&T Landfills RI/FS Scoping Document 1.3 Description of the study area	1. A summary of how the RI/FS is to be conducted in a manner consistent with §300.430(a) and (b) of the NCP.
2. Existing Data 2.1 Previous investigations 2.2 Data summary	2. A summary of the following Information: 2.1 Existing data pertaining to the characteristics of release or potential release 2.1.1 Previous investigations 2.1.2 Historical records
3. Conceptual Model of Release 3.1 Geology/Hydrology 3.2 Potential Contaminant Sources 3.3 Regional Gravel Aquifer (RGA) Contaminant Plumes 3.4 Potential Release and Exposure Pathways 3.5 Potential Contaminants of Concern (PCOCs) (Site-Related Constituents)	2.2 Conceptual model of release 2.2.1 Identify potential release and exposure pathways 2.2.2 Identify PCOCs
4. Response Scenarios 4.1 Likely Response Scenarios that are Potentially Applicable 4.2 Applicability of Presumptive Remedies and Innovative Technologies	2.3 Identify likely response scenarios, potentially applicable and applicability of presumptive remedies and innovative technologies
5. Scoping Data Needs 5.1 C-746-S&T Landfills 5.2 C-616 Lagoons 5.3 NSDD 5.4 Upgradient Plumes	2.4 Identify need for limited data collection efforts to assist RI/FS scoping
6. Data Quality Objectives 6.1 Define the Problem to be Resolved (DQO Step 1) 6.2 Define the boundaries of the Study (DQO Step 4) 6.3 C-746-S&T DQO Decision Network (DQO Steps 2, 3, and 5)	2.5 Identify the type, quality, and quantity (i.e., DQOs) of the data to be collected during the RI/FS
7. Applicable or Relevant and Appropriate Requirements 7.1 Chemical Specific 7.2 Location Specific 7.3 Action Specific	2.6 Initiate the identification of potential federal and state applicable or relevant and appropriate requirements (ARARs) and, as appropriate, other criteria, advisories, or guidance to be considered
8. Applicability of Streamlined Response Actions	3. Applicability of streamlined response actions: 3.1 Removals 3.2 Early remedial actions 3.2.1 Interim remedial actions 3.2.2 Final remedial actions

rules and data needs. Once agreement is reached on the DQOs, the RI/FS Work Plan can be developed to ensure that sufficient information has been collected to allow for remedy evaluation and selection.

1.2 PURPOSE AND GOALS OF THE C-746-S&T LANDFILLS RI/FS SCOPING DOCUMENT

The purpose of the scoping document in the RI/FS process is to set forth the investigative strategy, develop project DQOs, discuss the adequacy of existing data, and present potential response scenarios prior to development of the RI/FS Work Plan. The goal of this approach is to ensure that regulatory agencies and other stakeholders (i.e., Citizens Advisory Board) have the opportunity to provide input into the design of the RI/FS Work Plan, thereby minimizing comments on draft versions of the Work Plan.

1.3 DESCRIPTION OF THE STUDY AREA

The C-746-S&T Landfills RI focuses on the impact of contamination derived from the following SWMUs to area groundwater quality:

- SWMU 9—C-746-S Residential Landfill;
- SWMU 10—C-746-T Inert (Old Construction) Landfill; and
- SWMU 145—C-746-P Construction/Demolition Debris Disposal and Spoils Area.

The initial use of the area now occupied by the C-746-S&T Landfills complex for debris disposal remains undocumented. Anecdotal evidence and historical aerial photographs are sufficient, however, to show that the area (known as the McGraw and Subcontractor Discard Area and called C-746-P) was used for the disposal of site-related construction debris as early as the construction period of the plant (circa 1952). By 1973, the disposal area covered approximately 23 acres or 1 million ft^2 (Union Carbide 1973). This area has since been designated as SWMU 145 (see Sect. 1.3.6).

A preliminary design for the construction of the current C-746-S&T Landfills complex above the former C-746-P Landfill was completed in the late 1970s (DOE 1993a). Prior to the summer of 1980, the DOE retained Rust Engineering Company to design a sanitary landfill to handle normal "municipal refuse." Rust Engineering Company subcontracted Geraghty and Miller, Inc., to perform a hydrogeologic study of the proposed sanitary landfill site. In August 1980, Wehran Engineering (for Garaghty and Miller, Inc.) submitted a hydrogeologic assessment of the proposed sanitary landfill (field evaluation performed on June 18 and 20, 1980). These areas subsequently were permitted as the C-746-S Residential Landfill and the C-746-T Inert Landfill (see Sect. 1.3.1).

The term "Residential Landfill," as applied to the C-746-S Landfill, refers to a permitted facility for the proper disposal of solid waste including residential waste, commercial waste, institutional waste (and resulting sludge), industrial, or special waste with specific approval. The C-746-T Landfill is designated an "Inert landfill," which means it is a permitted facility for the proper disposal of inert, nonsoluble and nonputrescible solid waste, including construction materials, certain industrial or special wastes, and other waste material with specific approval. Certain putrescible wood product wastes (such as cardboard, paper, sawdust, wood chips, and tree trimmings) may be permitted for disposal at inert landfills. Both landfills are referred to as "Sanitary landfills," because they are permitted facilities for the disposal of solid waste that complies with 401 KAR 30:031 and 401 KAR 47:030.

Also included within the scope of this RI are several SWMUs and one AOC upgradient of the C-746-S&T Landfills. These upgradient units will be assessed to determine if they are the source of dissolved contamination present in groundwater beneath the C-746-S&T area. These areas, shown on Fig. 1.1, include the following:

- SWMU 17—C-616-E Sludge Lagoon;
- SWMU 18—C-616-F Full Flow Lagoon;
- SWMU 58—NSDD (outside plant security area);
- AOC 111—Concrete Rubble Pile 9A and 9B;
- SWMU 201—Northwest Plume; and
- SWMU 202—Northeast Plume.

The area immediately downgradient of the C-746-S&T Landfills (the C-746-U Landfill) also is included in the study area to aid in the interpretation of contaminant flow; however, data that may be evaluated from the U-Landfill will not be used to characterize the C-746-S&T Landfills. The U-Landfill data is not intended to be used in the characterization of the S&T Landfills, so that additional potential source areas will not be introduced.

Vertical boundaries of the study area addressed by the C-746-S&T RI/FS will include surface deposits and extend to a depth inclusive of the base of the Regional Gravel Aquifer (RGA) and the first McNairy sand.

1.3.1 SWMUs 9 and 10: C-746-S Residential Landfill and C-746-T Inert Landfill

1.3.1.1 C-746-S Landfill

On January 15, 1981, PGDP submitted an application to the Commonwealth of Kentucky to develop a residential landfill. PGDP was issued Construction Permit 073.14 (C-746-S Landfill) April 6, 1981, permitting an area of 16.8 acres for the landfill and allowing for a fill area of 9.0 acres (DOE 1993a).

In October 1981, PGDP initiated the relocation of a 0.3-mile section of the NSDD to allow construction of the C-746-S Landfill. The NSDD section was relocated approximately 200 ft west of its original location and construction of Cell Number 1 of the C-746-S Landfill was completed October 12, 1981 (DOE 1993a). PGDP began maintenance and operation of the C-746-S Residential Landfill in the early 1980s and the Landfill was used for the disposal of trash and garbage from PGDP until June 1995. Table 1.2 summarizes the key permit dates relative to the C-746-S Landfill.

Table 1.2. C-746-S Landfill: Chronology of permitting events

Date	Event
April 6, 1981	C-746-S: Permit to construct issued.
October 12, 1981	C-746-S: Construction of Cell No. 1 completed
October 14, 1987	C-746-S: Renewal of permit
April 14, 1988	C-746-S: Renewal of permit
September 13, 1988	C-746-S: Certified complete construction of Cell No. 2; begin final closure of Cell No. 1
July 3, 1989	C-746-S: Renewal of permit
May 8, 1990	Groundwater monitoring regulations were revised/restructuring of the Kentucky Department for Environmental Protection (KDEP) SWMU Program
October 1990	C-746-S: Certified closure of Cell No. 1.
December 31, 1991	C-746-S: Permit expired (renewal application pending).
July 22, 1992	C-746-S: KDEP issued letters of continuation.
January 25, 1993	C-746-S: Cell No. 3 was certified "complete."
April 12, 1993	C-746-S: Receipt of continuation letter authorizing operation of Cell No. 3
July 1993	Solid Waste Landfill Permit Modifications for the Inert and Residential Landfill Permits
June 1995	C-746-S: Certified closure of Cell No. 3

Initially, 110 parts per million (ppm) of uranium served as the waste acceptance criteria at the C-746-S Landfill. Later disposal standards used at the Landfill were 17 pCi/g of uranium, which corresponds to 25 ppm of uranium at natural assay. Waste materials proposed for disposal in the C-746-S Landfill were screened using a criterion of 100 counts per minute above background because there was no method for measuring the 17 pCi/g standard. No materials with detectable transuranics or technetium-99 (^{99}Tc) were disposed of in the Landfill (CH2M Hill 1992).

Initially, waste disposed of in the C-746-S Landfill was placed in a lined cell, compacted in place, and covered with soil. Later disposal procedures required that the waste be compacted prior to placement in the landfill cell. When a cell was filled, it was capped with clay and covered with soil. Because the waste cells in the C-746-S Landfill generally were constructed on top of the natural land surface, the vertical extent of buried waste material is assumed to be the height of the landfill (approximately 20 ft) (CH2M Hill 1992).

1.3.1.2 C-746-T Landfill

In 1985, PGDP applied for an inert landfill permit for the construction spoils area not covered by the C-746-S permit. The Commonwealth of Kentucky issued Construction Permit 073.15 (C-746-T Landfill) February 5, 1985. The new permit addressed 20.1 acres and authorized a fill area of 8.8 acres (DOE 1993b).

The C-746-T Landfill was used to dispose of construction debris (i.e., concrete, wood, and rock) and steam plant fly ash from PGDP until June 30, 1992. Table 1.3 summarizes key permit dates relative to the C-746-T Landfill. Consistent with the C-746-S Landfill, the C-746-T Landfill waste cells are assumed to be situated on top of the natural land surface; therefore, the vertical extent of buried waste is estimated at the height of the landfill (approximately 20 ft) (CH2M Hill 1992).

Table 1.3. C-746-T Landfill: Chronology of permitting events

Date	Event
February 5, 1985	C-746-T: Permit to construct issued.
May 8, 1990	Groundwater monitoring regulations were revised/restructuring of KDEP SWMU Program (more stringent regulations prompted closure of C-746-T Landfill).
June 30, 1992	C-746-T: Closure.
November 12, 1992	C-746-T: Landfill certified "closed."
July 1993	Solid Waste Landfill Permit Modifications for the Inert and Residential Landfill Permits.

1.3.2 SWMU 17: C-616-E Sludge Lagoon

SWMU 17, the C-616-E Lagoon, operated from 1977 to 1997 as a dewatering basin for sludge from the C-616 Liquid Pollution Abatement Facility. The Liquid Pollution Abatement Facility is a treatment facility originally used to reduce chromium from wastewaters of the cooling towers and other nearby facilities.

The C-616-E Sludge Lagoon is an L-shaped surface impoundment covering an area of 215,000 ft^2. It is constructed with a below-grade clay floor and above-grade earth/clay walls. The lagoon originally was designed to hold a maximum water depth of 3.8 m (12.5 ft); however, accumulation of sludge during lagoon operation has reduced this capacity. The depth of sludge (containing up to 2% chromium^{+3} by weight) currently present in the lagoon averages approximately 1.8 m (6 ft).

During operation, effluent from the C-616-E Lagoon was discharged through a 12-inch overflow pipe to the C-616-F Lagoon prior to discharge to Bayou Creek through the PGDP's Outfall 001 ditch system. Precipitation currently is the only source of flow entering the C-616-E Sludge Lagoon, and periodic discharges of the precipitation are routed to Outfall 001. During extreme rainfall events, some water from the lagoon may overflow and pond in swales on the east side of the Lagoon.

1.3.3 SWMU 18: C-616-F Full Flow Lagoon

SWMU 18, the C-616-F Full Flow Lagoon, began operation in 1977. This lagoon serves as a settling basin for effluent of the C-616 Liquid Pollution Abatement Facility and for water from the NSDD, which is pumped to the Lagoon by the C-616-C Lift Station. The C-616-F Lagoon is located adjacent to the C-616-E Sludge Lagoon, north of the fenced plant security area and across from the C-616 Liquid Pollution Abatement Facility.

The C-616-F Lagoon is a rectangular surface impoundment of 340,000 ft^2. Constructed at the same time as the C-616-E Sludge Lagoon, the C-616-F Lagoon also has a below-grade clay floor and above-grade earth/clay walls and was designed to hold a maximum water depth of 12 ft. When the C-616-E Sludge Lagoon was closed in 1997, walls and baffles of sheet piling were added to the east end of the C-616-F Lagoon and the C-616-F Lagoon began receiving the effluent from the C-616 Liquid Pollution Abatement Facility clarifier.

Overflow from the C-616-F Lagoon discharges through a weir on the west end of the C-616-F Lagoon to Bayou Creek via the Outfall 001 ditch system. Compliance monitoring at Outfall 001 to support a Kentucky Pollutant Discharge Elimination System permit shows that the ditch effluent meets required water quality standards. Precipitation accounts for a small amount of the flow from the C-616-F Full Flow Lagoon.

1.3.4 SWMU 58: NSDD (outside PGDP security-fenced area)

The NSDD, an original design surface channel of the PGDP, is located entirely on property owned by DOE. Parts of the NSDD follow a pre-PGDP drainage feature, while a portion of the ditch near the C-746-S&T was rerouted. The NSDD originates within the north central portion of PGDP and discharges into Little Bayou Creek to the north of the plant.

The portion of the NSDD outside of the PGDP security-fenced area (SWMU 58) is approximately 8,400 ft long. The average width of this portion of the ditch is approximately 32 ft, and the depth ranges from approximately 5 to 15 ft. The banks of this portion of the NSDD are generally vegetated with grasses and brush, and trees line some sections of the bank. Approximately 3,000 ft of the NSDD (i.e., that portion nearest to Little Bayou Creek) fall within the 500-year floodplain of Little Bayou Creek, and some portions of this segment fall within the 100-year floodplain (COE 1994). The NSDD outside of the PGDP security-fenced area is posted for radiological contamination (pursuant to 10 *CFR* 835 requirements).

Historically, the NSDD received wastewater from the C-400 Cleaning Building, coal pile runoff, and storm water. Discharges from C-400 processes began in 1957 (MMES 1995). The primary functions of the C-400 Cleaning Building included cleaning, metal plating, metals recovery, radioactive materials stabilization and recovery, uranium trioxide production, diffusion process equipment testing, and uranium tetrafluoride (green salt) pulverization. Sources of runoff to the ditch include a steam plant (C-600), process buildings (C-335 and C-337), a cooling tower (C-635), and electrical switchyards (C-535 and C-537). Due to the presence of contaminants in this runoff, the soil and sediment in the NSDD have been contaminated.

Over the years, fly ash and coal dust from the C-600 Steam Plant and sediment from the ditch watershed have nearly filled the southern (on-site) portion of the NSDD. This caused runoff from heavy rainfall events to overflow the ditch, primarily near 10th Street. In order to restore adequate flow, sediments periodically were dredged from the NSDD, and the spoils were placed near the banks of the ditch.

In 1977, the C-616-C Lift Station was constructed approximately 475 ft upstream of the plant security fence. This lift station diverts all normal flow (from upstream locations) in the NSDD to the C-616-F Full Flow Lagoon for settlement of suspended solids prior to discharge through the Outfall 001 ditch system to Bayou Creek.

The C-616-H Lift Station (Ditch 001 Lift Station) began operation in 1991. This lift station pumps effluent of the C-335 and C-337 Process Buildings and the C-535 and C-537 Switchyards into the NSDD for downstream capture by the C-616-C Lift Station and treatment through the C-616-F Full Flow Lagoon prior to discharge to Bayou Creek via the Outfall 001 ditch system.

In 1981 and 1982, a portion of the NSDD located north of Ogden Landing Road was relocated to its present configuration to facilitate construction of the C-746-S&T Landfills. The abandoned segment of the NSDD was filled and covered by clean soil placed during construction of the landfills; however, the area is outside of the permitted area of the C-746-S&T Landfills.

While contaminants in the NSDD surface soils and sediment outside of the PGDP security fence do exceed acceptable risk levels for the recreational receptor and exceed ecological benchmark values, the NSDD is not believed to be a significant, current source of contaminants leaching to the subsurface soils or to groundwater. Historically, contaminants that would be expected to have the potential to leach were released to the NSDD from process operations, primarily in the C-400 Building. However, these releases were confined inside the plant security fence in 1977 with the construction of lift-station C-616, and eliminated totally in 1994 with the addition of treatment for the remaining discharges from the C-400 Building. As a result, any contaminants present in the NSDD that had the potential to leach are expected already to have migrated.

1.3.5 Area of Concern 111: Concrete Rubble Piles 9A and 9B

AOC 111 includes two concrete rubble piles: AOC 111A and 111B. They are located on DOE property north of PGDP. Both rubble piles lie on the abandoned access road portion of Ogden Landing Road, which runs east to west through the DOE property north of PGDP. Traffic use of this access road has been restricted by the dumping of concrete construction spoils at the east and west ends of the road. AOC 111B is 740 ft long and is located on the west end of the abandoned access road. The east end of the access road is blocked by AOC 111A, which is 211 ft long. Some of the concrete contained in these rubble piles is from PGDP and consists of very large pieces that possibly were used as footing material for transmission towers. The approximate volume of the concrete contained in these two piles is 1,500 yd^3. A detailed beta and gamma radiation survey and surface soil sampling were conducted at this AOC in November 1995, as part of a RCRA Facility Investigation (RFI). The subsequent RFI Report, Proposed Plan, and ROD documented that No Action was required; however, in 2001, these concrete rubble piles were relocated to inside the PGDP security fence as part of an effort to clean up the West Kentucky Wildlife Management Area. The radiation survey was conducted on a 20-ft grid pattern. A total of 28 grids was surveyed, and it was concluded that 13 of the grids showed levels of radiation that exceeded Oak Ridge Operation Radioactive Contamination Control Policy for nonwork-surface contamination in a nonradiological area (3,000 dpm/100 cm^2).

1.3.6 SWMU 145: C-746-P Construction/Demolition Debris Disposal and Spoils Area

SWMU 145 (C-746-P) is located north of the PGDP security area and encompasses SWMUs 9 and 10. SWMU 145 is approximately 44 acres in size and disposal operations began in the early 1950s. A 1973 document *"The Discard of Scrap Materials by Burial at the Paducah Plant,"* (Union Carbide 1973), states that the PGDP construction contractor used this area to discard all types of scrap and waste materials. Use of the area for the discard of scrap and waste by subcontractors was continued until the early 1980s. It is suspected that construction/demolition debris (such as concrete), roofing materials, wire, wood, shingles with asbestos, and welding rods were disposed of in the area. Approximately once a year, the accumulated scrap piles were moved by plant personnel into consolidated piles or earth depressions and, wherever practicable, covered with dirt. The area later was permitted for the construction and operation of the C-746-S&T Landfills.

1.3.7 SWMU 201: Northwest Plume

Following the identification of contaminated groundwater in residential wells north of the PGDP in August 1988, the DOE conducted investigations to determine the nature and extent of groundwater contamination and to identify potential sources. These investigations, combined with related independent studies, have characterized a groundwater plume known as the Northwest Plume within the RGA and the Upper Continental Recharge System (UCRS).

These investigations concluded that the primary contaminants of the Northwest Plume are trichloroethene (TCE) (up to 16,000 μg/L) and ^{99}Tc (up to 4,800 pCi/L), with only trace amounts of TCE degradation products [1,1-dichloroethene (DCE) and 1,2-DCE]. The only significant occurrences of elevated TCE degradation products (up to 3,000 μg/L vinyl chloride and 4,800 μg/L 1,2-DCE) were confined to localized areas of the UCRS.

The Northwest Plume Investigation (DOE 1995) measured high levels of TCE and ^{99}Tc in water samples from the upper RGA and UCRS in the northwest corner of the plant; however, the highest contaminant levels were present at the base of the RGA. The investigation report implied two sources for the Northwest Plume: the C-747-A Burial Grounds (located in the northwest corner of the plant) and the C-400 Cleaning Building (located in central area of the plant). Upgradient samples of the Northwest Plume Investigation and later samples collected for the Northeast Plume Investigation indicated that the C-400 Cleaning Building was the location of the main, dense nonaqueous-phase liquid (DNAPL) zone sourcing contamination in the Northwest Plume.

Other findings of the Northwest Plume Investigation included:

- the leading edge and western boundary of the Northwest Plume are poorly known; and
- a high-hydraulic conductivity zone within the RGA influences the plume geometry.

1.3.8 SWMU 202: Northeast Plume

Investigations conducted between March and December 1994 characterized the Northeast Plume in the RGA at PGDP and identified the primary contaminants as TCE and ^{99}Tc. Concentrations of TCE and ^{99}Tc in Northeast Plume samples ranged up to 6,700 μg/L and 712 pCi/L, respectively. Occurrences of ^{99}Tc in the Northeast Plume are limited to areas located within and immediately adjacent to the PGDP security fence. Sample analyses of many on-site RGA water samples and some McNairy Formation water samples reported the presence of TCE degradation products; but, generally, the concentrations reported for the TCE degradation products were low.

The primary conclusions of the Northeast Plume Investigation, based on the contaminant distribution, were as follows:

- the southern edge of the Northeast Plume is sharply defined;

- the extent of contamination at the top of the RGA differs from the extent of contamination at the base of the RGA; and

- the C-400 area is a primary source of the Northwest Plume.

The *Northeast Plume Preliminary Characterization Summary Report* (DOE 1995) concluded that the general presence of the highest dissolved TCE levels at the base of the RGA suggested the presence of a DNAPL source(s) for the Northeast Plume. The presence of high dissolved TCE concentrations at the top of the RGA also may indicate proximity to a UCRS DNAPL source zone. The Northeast Plume is not thought to affect the C-746-S&T Landfills.

2. EXISTING DATA

2.1 PREVIOUS INVESTIGATIONS

Several investigations have taken place within the boundary of the C-746-S&T RI area. The following lists key projects from which data was examined during this scoping phase of the RI and the years in which the data were collected. These datasets are available in the Paducah Oak Ridge Environmental Information System (OREIS) database and are also provided on the enclosed CD as Appendix D.

- Results of the Site Investigation, Phase I (1990, Paducah OREIS project "PHASE1");
- Historical data from AnaLIS for Waste Area Group (WAG) 28 DQO (1990, Paducah OREIS project "HISTWAG28");
- Results of the Site Investigation, Phase II (1991, Paducah OREIS project "PHASE2");
- Drive-Point Profiling of the Northwest Plume (1993, Paducah OREIS project "1110505");
- PCB Contamination Study (1994, Paducah OREIS project "3PADPCB");
- Northeast Plume Preliminary Characterization (1994, Paducah OREIS project "1110101");
- Remedial Investigation for the Waste Area Grouping 17 (1995, Paducah OREIS project "1090703");
- Remedial Investigation for the Waste Area Grouping 28 (1999, Paducah OREIS project "ERI99-W28C-193") (installation of MW353);
- Sitewide Remedial Evaluation for Source Areas Contributing to Off-Site Groundwater Contamination (1999, Paducah OREIS projects "ERI99-W-DG" and "ERI99-W-DGC");
- Data collected in support of the False Claims Investigation (1999–2000, Paducah OREIS projects "PLDHSS99-01," "PLDJNS00-01," "PLDJNS00-07," and "PLDJSS99-01");
- State Split Sampling of Area Near SWMU 145 (1999, Paducah OREIS project "ERI99-BP-SWMU45");
- NSDD Screening (2000, Paducah OREIS project "ERI00-NS-SCRN");
- Monitoring Well Corrosion Study (2000, Paducah OREIS project "SGC01-01");
- Limited Sampling of Outfall 008, 010, and Section 3A of NSDD (2000, Paducah OREIS project "ERI01-NS-SCRN2");

- Routine quarterly groundwater monitoring for C-746S&T Landfills (1988 through October 2001, Paducah OREIS projects "C746S-88" through "C746S-96," "C746SG97-01," through "C746SG97-05," "SG98-01" through "SG98-04," "SG99-01" through "SG99-04," "SG00-01" through "SG00-04," "SG01-01" through "SG01-04," and "SG02-01");

- Routine quarterly groundwater monitoring for C-746-U Landfill (1995 through October 2001, Paducah OREIS projects "C746U-95," "C746UG97-01" through "C746UG97-04," "UG98-01" through "UG98-04," "UG99-01" through "UG99-04," "UG00-01" through "UG00-04," "UG01-01" through "UG01-04," and "UG02-01");

- Routine environmental surveillance groundwater data (1988 through 2001, Paducah OREIS projects "EM-GW-88" through "EM-GW-96," "GWES97-01" through "GWES97-04," "GWES98-01" through "GWES98-03," "GWES98-07," "GWES99-01" through "GWES99-04," "GWES99-12," "GWES00-01" through "GWES00-04," "GWES00-06," "GWES00-13," "GWES01-01," "GWES01-02," "GWES01-04," "GWES01-06," "GWES01-08," and "GWES02-01,"); and

- Annual Sediment Sampling (1989 through 2001, Paducah OREIS projects "EMP-SD89" through "EMP-SD99," "EMPSD00," and "EMPSD01-01").

2.2 DATA SUMMARY

2.2.1 Sediment/Surface Soil

During previous investigations, the sediment and surface soil within the C-746-S&T Landfills RI study area have been characterized by the collection of samples from 70 discrete sampling stations. Sediment/ surface soil samples are defined as those sediment and soil samples collected at depths from 0 to 1 ft below ground surface (bgs). Figure 2.1 shows the locations of each of the historical sediment/surface soil sample stations.

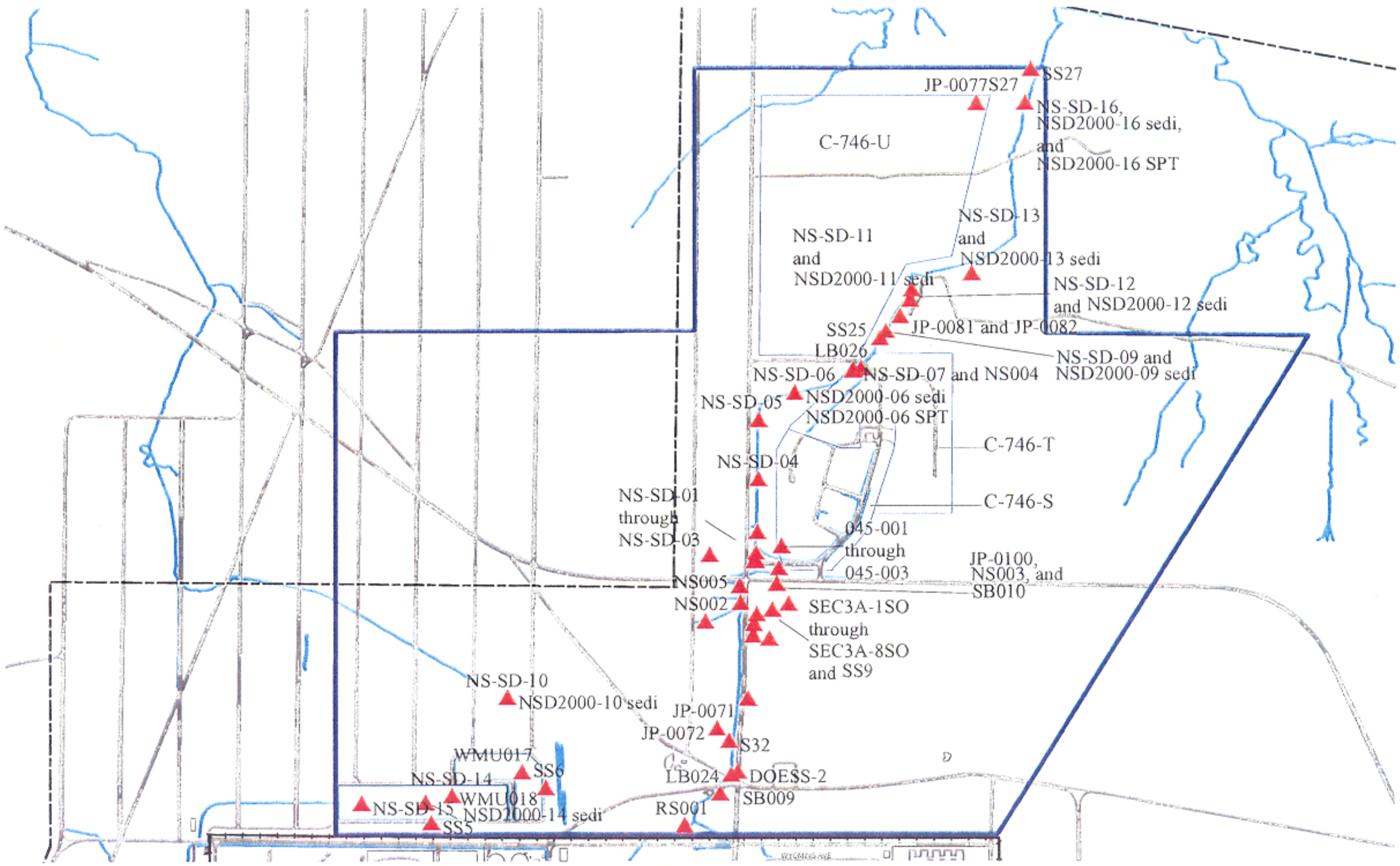
The sediment/surface soil potential contaminants of concern (PCOCs) identified for this RI are those contaminants that have been detected at elevated levels in groundwater in the vicinity of the C-746-S&T Landfills. These PCOCs include volatile organic compounds (VOCs) TCE and 1,1-DCE, inorganics and metals (antimony, arsenic, barium, beryllium, cadmium, chromium, fluoride, lead, thallium, and uranium), and radionuclides [radon-222, ^{99}Tc, uranium (U)-234, ^{235}U, and ^{238}U]. A discussion of the process utilized for PCOC selection is provided in Sect. 3.5, Potential COCs (Site-Related Constituents). The following sections summarize the historical analytical data available for each of these PCOCs within the study area.

2.2.1.1 VOCs

Fifteen sediment/surface soil samples from the specified study area were analyzed for TCE; none were analyzed for 1,1-DCE. TCE was not detected in any of the samples.

2.2.1.2 Inorganics and Metals

Sixty-seven sediment/surface soil samples from the study area were tested for the metal PCOCs specified above. To determine which of these analytes might represent site-related contaminants, the analytical results were compared to historical data representative of naturally occurring conditions and concentrations in surface soil at PGDP (i.e., background data). Background values for metals were obtained from DOE (DOE 2001a). Table 2.1 lists these background values and provides summary information on the historical inorganic and metal analyses available from the study area.



LEGEND

- ▲ STATION LOCATIONS
- LANDFILL BOUNDARIES
- C-746-S&T RI STUDY AREA
- PLANT BOUNDARY
- DOE BOUNDARY
- STREAM

500 0 500 1000 Feet

TRUE NORTH PLANT NORTH

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.1. Historical sediment/surface soil sampling locations within C-746-S&T RI study area.

FIGURE No. c5ac90001sk393.apr
DATE 04-23-02

22

Table 2.1. Summary of historical inorganic and metal analyses in sediment/surface soil

PCOC	No. of samples analyzed	No. of detections	No. of detection above background	Background (mg/kg)	Range of detection results above background (mg/kg)
antimony	60	10	10	0.21	0.5 – 1320
arsenic	48	30	0	12	—
barium	60	60	6	200	209 – 1160
beryllium	66	35	25	0.67	0.68 – 8.5
cadmium	60	6	6	0.21	0.8 – 2.9
chromium	66	65	50	16	16.1 – 31,488
fluoride	0	—	—	Not defined	—
lead	60	37	9	36	37.8 – 106
thallium	60	17	17	0.21	0.56 – 120
uranium	39	29	29	Not defined	2.18 – 260

Of the ten inorganic/metal PCOCs identified for the C-746-S&T RI scope, eight were detected in sediment and surface soil within the study area at concentrations in excess of background values. These elevated contaminant concentrations were identified in sediment and surface soil samples collected from the NSDD and from the C-616 Lagoon area. While both these areas exhibited metals contamination in excess of background, contamination from antimony (three samples ranging from 352 to 1,320 mg/kg), barium (two samples ranging from 494 to 1,160 mg/kg), chromium (six samples ranging from 1960 to 31,488 mg/kg), and thallium (one sample at 120 mg/kg) was significantly higher at the C-616 Lagoons.

2.2.1.3 Radionuclides

Sixty-two sediment/surface soil samples from the study area were tested for the radionuclide PCOCs specified above. As with metals, the radionuclide analytes were compared to historical data representative of naturally occurring conditions and concentrations in surface soil at PGDP (i.e., background data) to determine which might represent site-related contaminants. Background values for radionuclides were obtained from DOE (DOE 2001a). Table 2.2 lists these background values and provides summary information on the historical radionuclide analyses available from the study area.

Table 2.2. Summary of historical radionuclide analyses in sediment/surface soil

PCOC	No. of samples analyzed	No. of detections	No. of detection above background	Background (pCi/g)	Range of detection results above background (pCi/g)
radon-222	0	—	—	Not defined	—
technetium-99	62	58	52	2.5	2.91 – 4700
uranium-234	56	55	34	2.5	2.6 – 120
uranium-235	43	43	25	0.14	0.15 – 12
uranium-238	56	55	45	1.2	1.63 – 314.1

Four of the C-746-S&T RI designated radionuclide PCOCs were identified within the study area at activities that exceeded background. While each of the radionuclide PCOCs was detected in sediment/surface soil samples from the C-616 Lagoons area, including the highest sediment/surface soil detection of ^{99}Tc (4,700 pCi/g), most sediment/surface soil samples that exhibited elevated radionuclide PCOC activities were collected from the NSDD. Within the NSDD, contaminant activities tended to be highest in sediment/surface soil samples collected from the ditch just north of the PGDP security fence. Radionuclide PCOC activities detected within this area included ^{99}Tc (seven samples ranging from 477 to 3,900 pCi/g); ^{234}U (three samples ranging from 54.5 to 120 pCi/g); ^{235}U (eight samples ranging from 1.2 to 12 pCi/g); and ^{238}U (eight samples ranging from 54.2 to 314.1 pCi/g).

2.2.2 Subsurface Soil

Subsurface soil samples have been collected from 166 boreholes during historical investigations within the C-746-S&T Landfills RI study area. Subsurface soil samples are defined as soil samples collected at depths greater than 1 ft bgs. Figure 2.2 shows these boring locations.

The subsurface soil PCOCs identified for this RI are the same as those defined for sediment/surface soil. The historical analytical data for these PCOCs from stations within the study area are summarized in the following sections.

2.2.2.1 VOCs

Ninety-four subsurface soil samples from the study area were tested for TCE. None were tested for 1,1-DCE. Table 2.3 provides summary information on these historical analyses.

Table 2.3. Summary of historical VOC analyses in subsurface soil

PCOC	No. of samples analyzed	No. of detections	No. of detection above background	Background (µg/kg)	Range of detection results (µg/kg)
TCE	94	3	—	Not defined	2 – 3
1,1 DCE	0	—	—	Not defined	—

Each of the three historical TCE detections was obtained from the abandoned MW181 borehole, located just south of the C-746-S&T Landfills. The highest result, 3 µg/kg, was detected in a soil sample collected from 5 to 10 ft bgs; a duplicate of this sample contained 2 µg/kg. The third detection, 2 µg/kg, was obtained from a soil sample collected at 25 to 30 ft bgs.

2.2.2.2 Inorganics and Metals

One hundred twenty-eight subsurface soil samples from the study area were tested for the inorganic and metal PCOCs specified above. A summary of these historical metal analyses is provided in Table 2.4. Also listed in Table 2.4 are the subsurface soil background values obtained from DOE (DOE 2001a) and the number of historical inorganic and metal PCOC analyses in subsurface soil that exceeded background values.

Table 2.4. Summary of historical inorganic and metal analyses in subsurface soil

PCOC	No. of samples analyzed	No. of detections	No. of detection above background	Background (mg/kg)	Range of detection results above background (mg/kg)
antimony	84	6	6	0.21	0.55 – 17.9
arsenic	107	79	0	7.9	—
barium	110	109	4	170	176 – 300
beryllium	101	77	27	0.69	0.69 – 2.08
cadmium	112	38	38	0.21	0.26 – 8.03
chromium	115	114	13	43	45.08 - 268
fluoride	0	—	—	Not defined	—
lead	112	73	14	23	23.8 – 583.2
thallium	84	9	1	0.34	76.05
uranium	61	47	47	Not defined	0.16 – 311

25

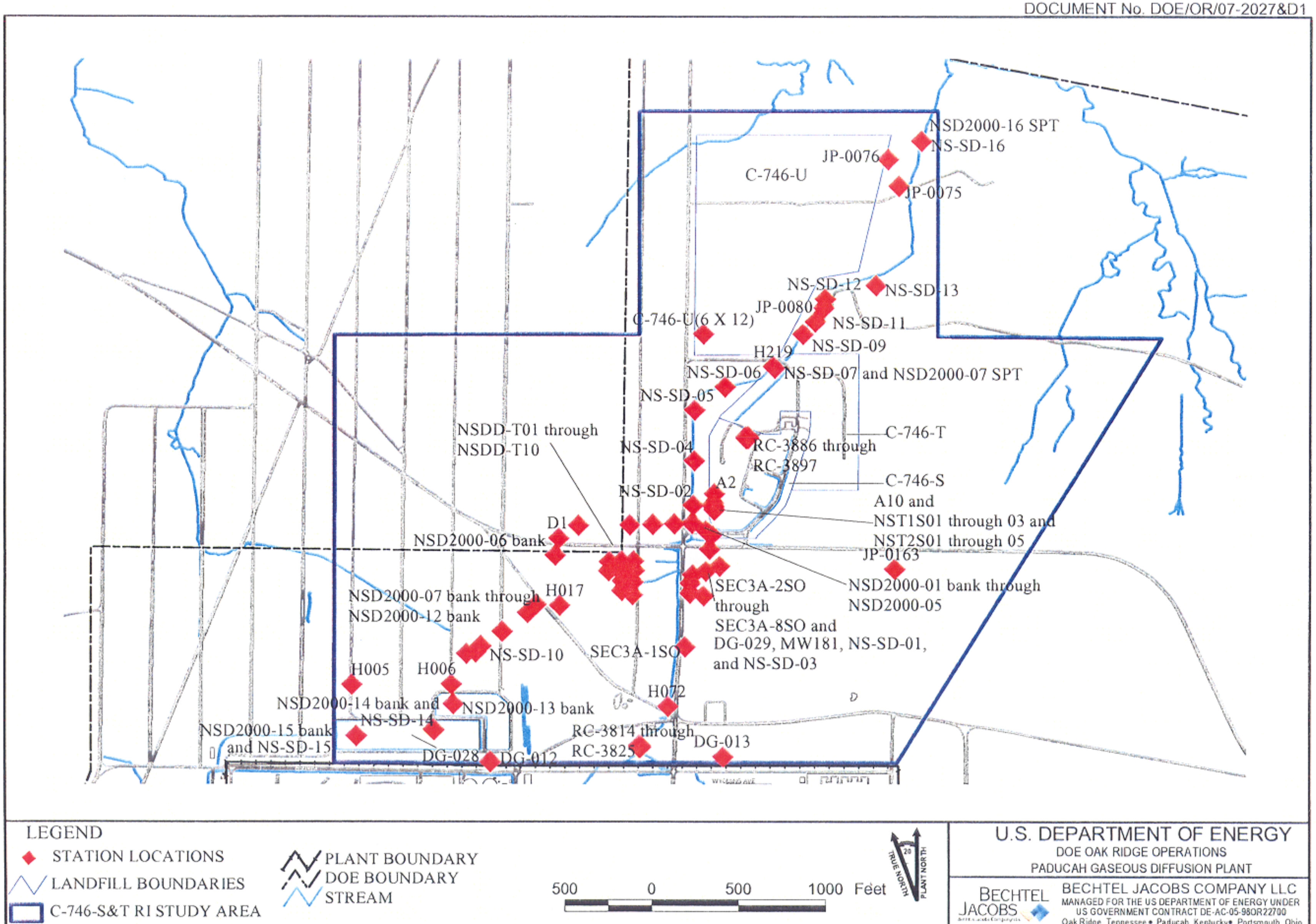


Fig. 2.2. Historical subsurface soil sampling locations within C-746-S&T RI study area.

FIGURE No. c5ac90001sk392.apr
DATE 04-22-02

Eight metal PCOCs were detected in subsurface soil within the study area at concentrations in excess of background values. Elevated concentrations of chromium, lead, and uranium were detected in the shallow subsurface soil (1 to 15 ft bgs) along the NSDD, while concentrations of barium, beryllium, and cadmium in excess of background were detected at depths from 1 to 70 ft bgs beneath the NSDD. Elevated concentrations of antimony were detected 40 to 60 ft bgs at sampling station H219, just south of the C-746-S&T Landfills; a thallium concentration in excess of background was detected at one sampling station (D1) west of the landfills (no sample depth was available in Paducah OREIS).

Cadmium, chromium, and beryllium concentrations that exceeded background values also were detected beneath the C-616 Lagoons. Elevated concentrations of cadmium were detected from 1 to 70 ft bgs, of chromium from 30 to 64 ft bgs, and of beryllium from 24 to 54 ft bgs.

2.2.2.3 Radionuclides

Ninety-seven subsurface soil samples from the study area were tested for the radionuclide PCOCs specified above. As with metals, the radionuclide analytes were compared to historical data representative of naturally occurring conditions and concentrations in surface soil at PGDP (i.e., background data) obtained from DOE (DOE 2001a). Table 2.5 lists these background values and provides summary information on the historical radionuclide analyses available from the study area.

Table 2.5. Summary of historical radionuclide analyses in subsurface soil

PCOC	No. of samples analyzed	No. of detections	No. of detection above background	Background (pCi/g)	Range of detection results above background(pCi/g)
radon-222	0	—	—	Not defined	—
technetium-99	94	53	34	2.8	3.09 – 1192.85
uranium-234	75	58	24	2.4	3 – 254
uranium-235	69	47	21	0.14	0.141 – 3.201
uranium-238	80	73	54	1.2	1.249 – 326

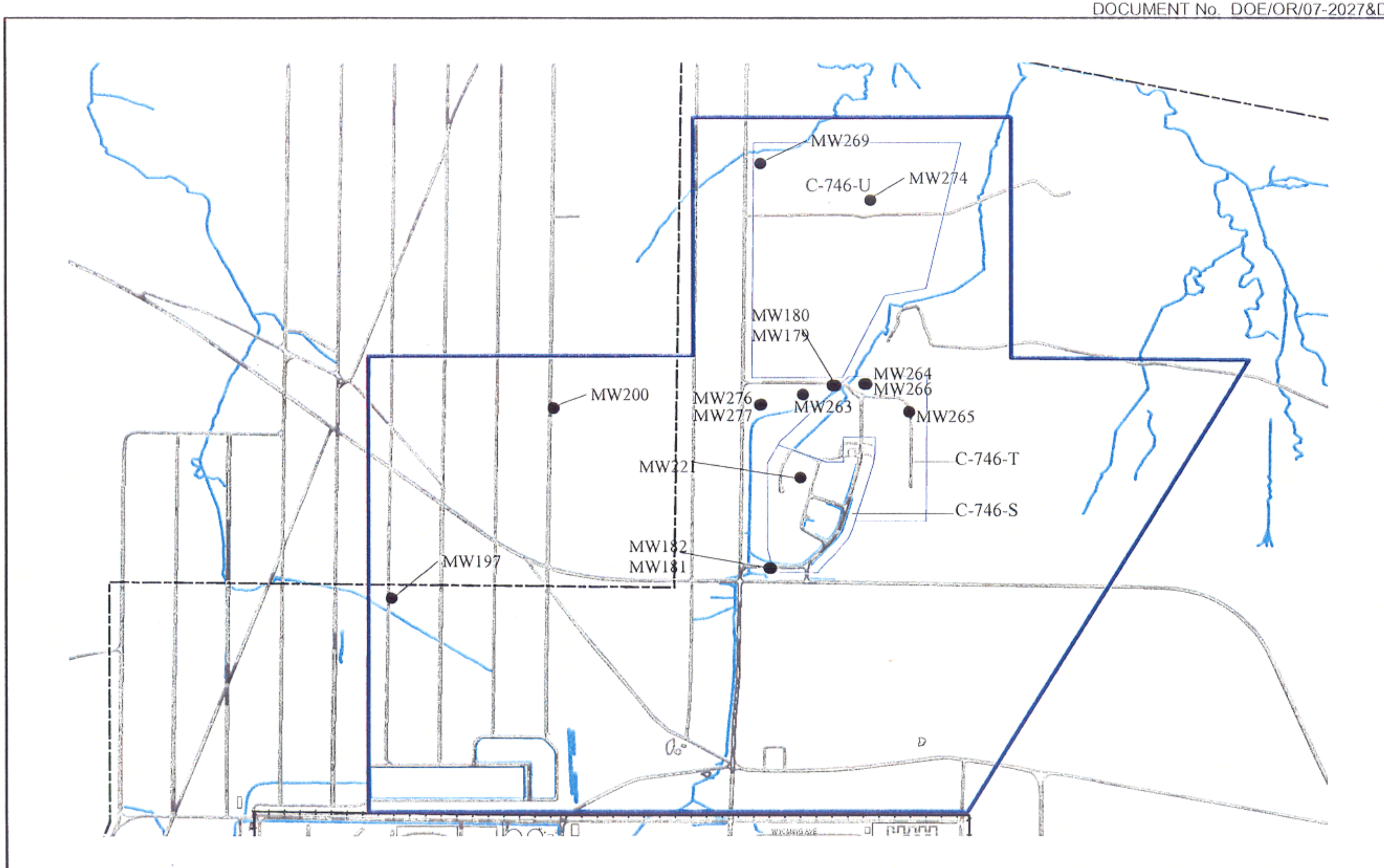
Four of the five defined radionuclide PCOCs (^{99}Tc, ^{234}U, ^{235}U, and ^{238}U) were detected within the study area at concentrations in excess of background. All elevated detections came from shallow subsurface soil samples (1 to 15 ft bgs) collected from sampling stations along the NSDD.

2.2.3 Groundwater

Groundwater data has been collected in the study area since 1988, using both monitoring wells and temporary borings. The sampling stations include 5 UCRS monitoring wells, 36 RGA monitoring wells, 1 McNairy monitoring well, 3 Rubble Zone monitoring wells, and 1 residential well. There also are 5 piezometers and 16 temporary borings that have provided groundwater data. Figure 2.3 shows these sampling locations.

The groundwater PCOCs identified for this RI are those contaminants that have been detected at elevated levels in groundwater in the vicinity of the C-746-S&T Landfills. These PCOCs include VOCs (TCE and 1,1-DCE); inorganics and metals (antimony, arsenic, barium, beryllium, cadmium, chromium, fluoride, lead, thallium, and U); and radionuclides (radon-222, ^{99}Tc, ^{234}U, ^{235}U, and ^{238}U). A discussion of the process utilized for PCOC selection is provided in Sect. 3.5, Potential COCs (Site-Related Constituents). The following sections summarize the historical analytical data available for each of these PCOCs within the study area.

DOCUMENT No. DOE/OR/07-2027&D1



LEGEND
- ● STATION LOCATIONS
- LANDFILL BOUNDARIES
- C-746-S&T RI STUDY AREA
- PLANT BOUNDARY
- DOE BOUNDARY
- STREAM

500 0 500 1000 Feet

TRUE NORTH PLANT NORTH

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.3. Historical groundwater sampling locations within C-746-S&T RI study area.

FIGURE No. c5ac90001sk393r1.apr
DATE 06-28-02

27

2.2.3.1 VOCs

Within the study area, a total of 1,528 groundwater samples have been analyzed for TCE, including 1,404 samples from monitoring wells and 124 samples from one-time sampling of temporary borings. A second PCOC – 1,1-DCE – was analyzed for in 991 groundwater samples, including 892 monitoring well samples and 99 samples from one-time sampling events. Table 2.6 provides a summary of the historical volatile data from the study area. The table breaks the information down by well versus boring, and by horizon.

Table 2.6. Summary of historical VOC analyses in groundwater

COC	No. of samples analyzed	No. of detections	No. of detection above MCL	MCL (µg/L)	Range of detection results above MCL (µg/L)
TCE – Total	1528	720	357	5	2200 – 5
MW	1404	665	325	5	610 – 5
Borings	124	55	32	5	2200 – 5
TCE – UCRS	95	14	5	5	58 – 12
MW	88	10	5	5	58 – 12
Borings	7	4	0	5	—
TCE – RGA	1369	685	350	5	2200 – 5
MW	1265	640	320	5	610 – 5
Borings	104	45	30	5	2200 – 5
TCE – McNairy	40	18	2	5	7.7 – 7.2
MW	27	12	0	5	—
Borings	13	6	2	5	7.7 – 7.2
TCE – Rubble Zone	24	3	0	5	—
MW	24	3	0	5	—
Borings	0	—	—	5	—
1,1-DCE – Total	991	8	2	5	10 – 8.7
MW	892	0	—	5	—
Borings	99	8	2	5	10 – 8.7
1,1-DCE – UCRS	39	0	—	5	—
MW	32	0	—	5	—
Borings	7	0	—	5	—
1,1-DCE – RGA	902	8	—	5	—
MW	829	0	—	5	—
Borings	73	8	2	5	10 – 8.7
1,1-DCE – McNairy	18	0	—	5	—
MW	7	0	—	5	—
Borings	11	0	—	5	—
1,1-DCE – Rubble Zone	24	0	—	5	—
MW	24	0	—	5	—
Borings	0	0	—	5	—

Trichloroethene

In the UCRS, the only detections above the maximum contaminant level (MCL) were in MW180 and MW182. MW180 is on the north side of the C-746-S&T Landfills, while MW182 is on the south side as illustrated on Fig. 2.2. Each well had TCE values above the MCL: once in 1991 when the wells were first sampled, and once in March 1994. MW180 also showed TCE above the MCL in June 1994. The trend graphs for these wells are presented in Appendix C. The exceedances appear as isolated spikes. All other analyses have been below the MCL or non-detects. No clear trends in the UCRS are apparent from the available data. A map showing the UCRS TCE data points is shown in Appendix B.

The majority of the data in the RGA is from monitoring wells associated with compliance monitoring at the C-746-S&T Landfills. Within the study area only two wells not associated with the C-746-S&T Landfills, MW197 and MW200, are currently monitored. MW197, near the western edge of the study area increased from an initial value of 2 µg/L to a high of 16 µg/L in 1996 and has since declined back to 2 µg/L. MW200 west and north of the landfills has remained below 5 µg/L since sampling began in 1993. In the vicinity of the landfills three wells – MW221, MW276, and MW277 – have shown declines in TCE concentrations since 1996. These wells are situated on the west and northwest side of the landfills. Wells near the center and southeast edge of the landfills either do not have detectable TCE or are below the MCL; however, on the north and northeast side of the landfills, TCE concentrations in seven wells have increased from the initial sampling. Initial concentrations in all seven wells – MW179, MW263, MW264, MW265, MW266, MW269, and MW274 – were below the MCL of 5 µg/L. Five of the seven now have increased in concentration to above the MCL. The concentration trend plots for the monitoring wells are contained in Appendix C.

Groundwater data collected from temporary borings provide a snapshot of conditions at the time the boring was sampled. Of the 14 temporary borings that provided RGA groundwater data within the study area, 7 are more than seven years old and no longer represent groundwater conditions. The remaining seven borings, all associated with the "Data Gaps" investigation, were sampled in 1999. Of these seven, DG-007, at the south edge of the study area, contained the highest TCE concentrations in the RGA at 2200 µg/L. This boring also represents the highest groundwater TCE concentration within the study area. Figures 2.4, 2.5, and 2.6 show TCE concentrations in the upper, middle, and lower portions of the RGA within the study area.

The TCE detections within the McNairy Formation groundwater are generally below the MCL. Only 2 of 40 samples were above the MCL, both from temporary borings from the Phase IV investigation in 1994. TCE was detected at 1 µg/L in the initial samples in the three Rubble Zone wells, but subsequent sampling has not detected any TCE.

1,1-Dichloroethene

Within the study area, 1,1-DCE was detected in only 8 of 991 samples. Only two samples were above the MCL of 5 µg/L. All the detections were in the RGA in two temporary borings, DG-007 and DG-008, located at the south edge of the study area. Both detections above the MCL were in DG-007.

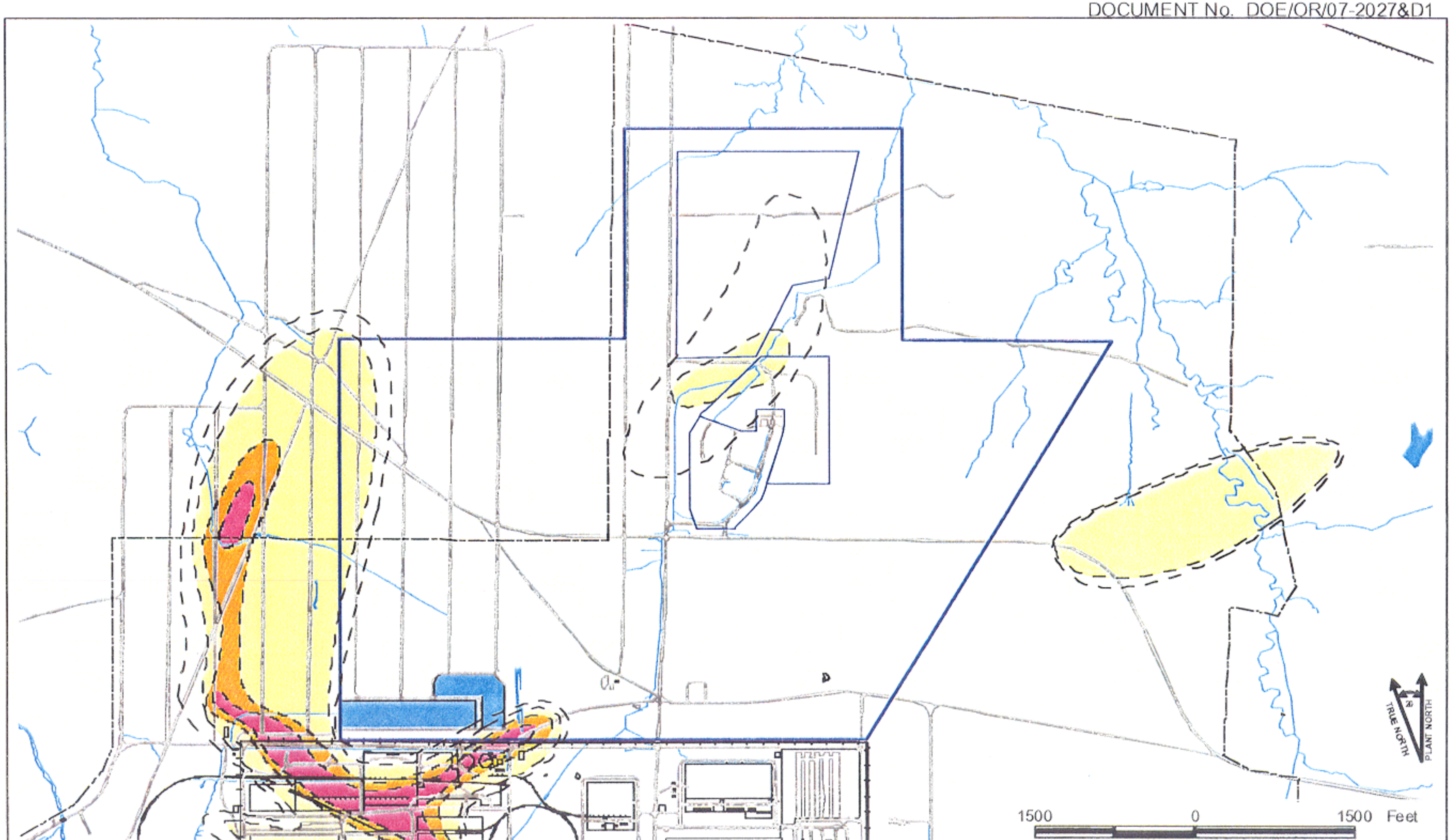
2.2.3.2 Inorganic and Metal Contaminants

The investigation area database of metals in groundwater contains analyses representing 5 UCRS wells, 39 RGA wells, 1 McNairy well, and 3 Rubble Zone wells. Note, three area soil borings (DG-007, DG-009, and DG-021) have metals analyses for groundwater samples that are not being considered because water samples from soil borings typically are biased by suspended particulates that would not be present in well water samples. In addition, the three Rubble Zone wells have only uranium analyses and sample groundwater far below the depth of interest for this investigation and will not be considered further.

The ranges of inorganics and metal concentrations in groundwater of the investigation area were compared to MCLs to assess which of these analytes might indicate site-related contaminants. Table 2.7 lists the MCLs and summary information on the historical metal analyses available from the study area.

Of the ten inorganics and metals identified for assessment for the C-746 S&T Landfills investigation, all have been detected in at least one well or soil boring at levels in excess of MCLs. However, in most cases, these exceedances are singular events that are not representative of water quality. The data are sufficient to show that arsenic, barium, fluoride, and uranium are less than MCLs in both total and dissolved samples.

DOCUMENT No. DOE/OR/07-2027&D1



LEGEND

- DOE BOUNDARY
- ROAD
- STREAM
- LANDFILL BOUNDARY
- C-746-S&-T RI SCOPING AREA
- ISOCONCENTRATION BOUNDARY (INTERPRETED)

TCE CONCENTRATIONS (ug/L)
>100,000
10,000 - 100,000
1,000 - 10,000
100 - 1,000
5 - 100
1 - 5

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee Paducah, Kentucky Portsmouth, Ohio

SAIC

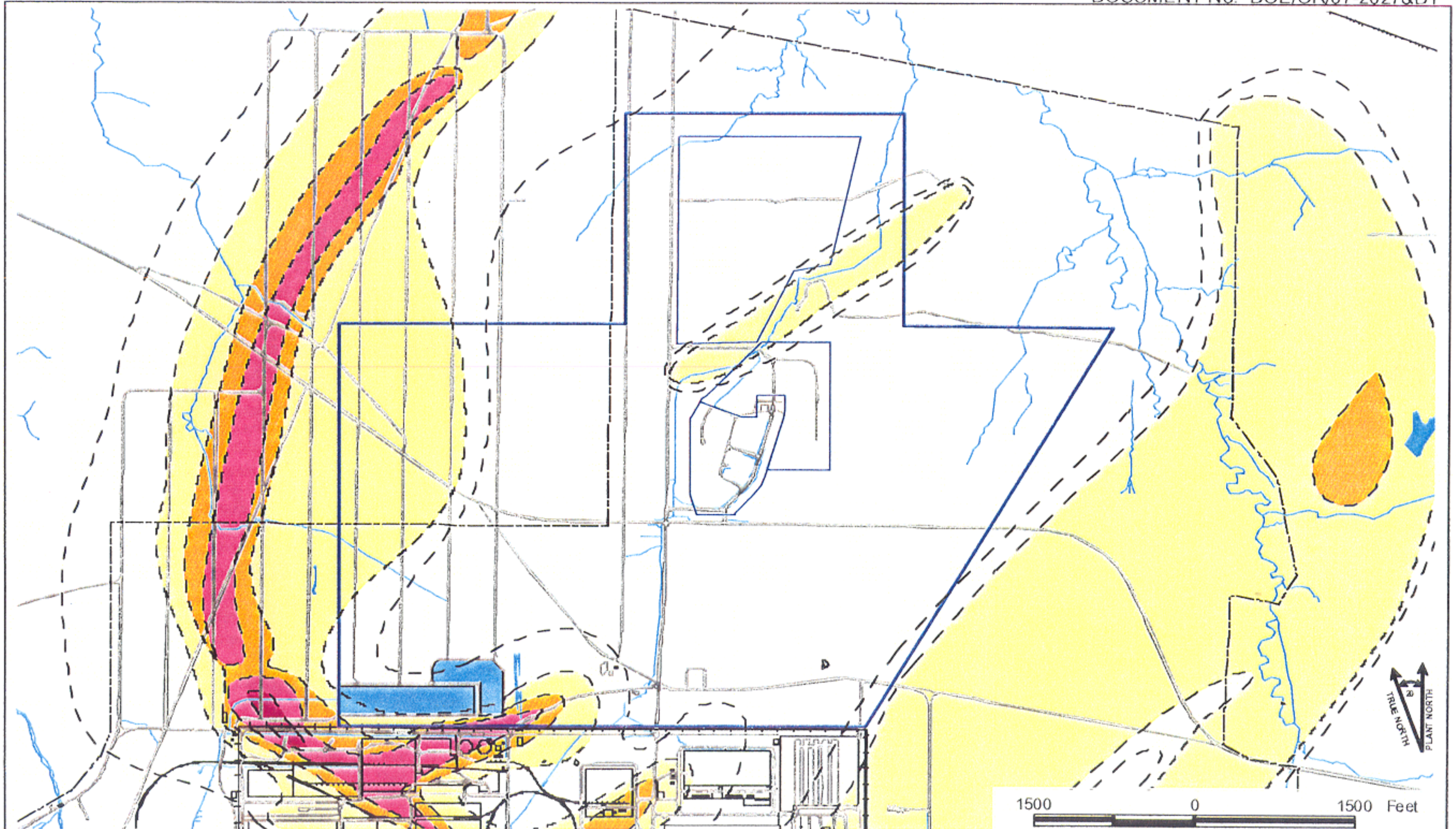
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.4. Trichloroethene in the upper RGA for 2001.

FIGURE No. c5ac90001sk455.apr
DATE 07-08-02

30

DOCUMENT No. DOE/OR/07-2027&D1



LEGEND

- DOE BOUNDARY
- ROAD
- STREAM
- LANDFILL BOUNDARY
- C-746-S&-T RI SCOPING AREA
- ISOCONCENTRATION BOUNDARY (INTERPRETED)

TCE CONCENTRATIONS (ug/L)

- >100,000
- 10,000 - 100,000
- 1,000 - 10,000
- 100 - 1,000
- 5 - 100
- 1 - 5

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee · Paducah, Kentucky · Portsmouth, Ohio

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.5. Trichloroethene in the middle RGA for 2001.

FIGURE No. c5ac90001sk456.apr
DATE 07-08-02

31

32

DOCUMENT No. DOE/OR/07-2027&D1

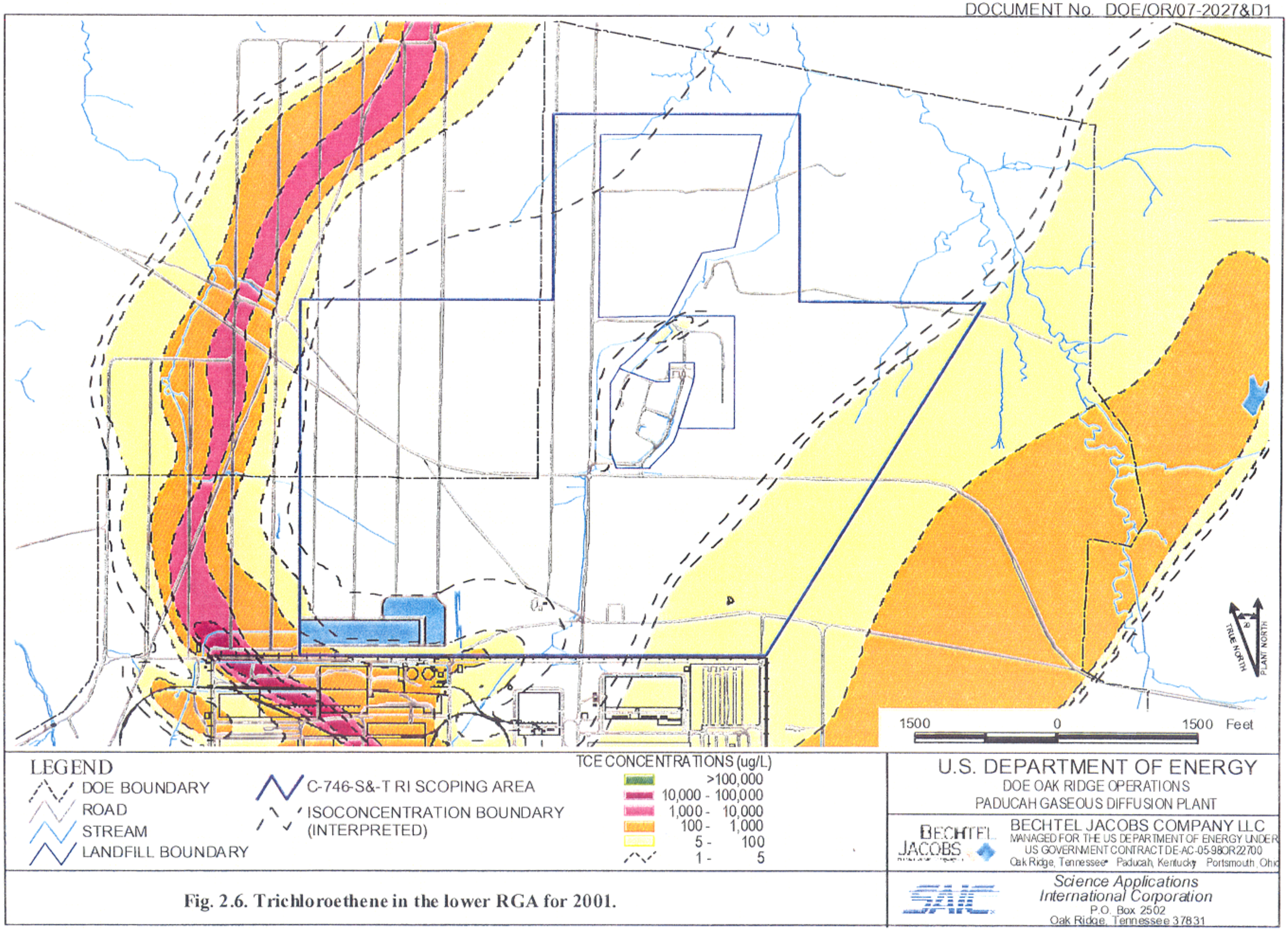


Fig. 2.6. Trichloroethene in the lower RGA for 2001.

FIGURE No. c5ac90001sk457r1.apr
DATE 07-08-02

Table 2.7. Summary of historical inorganic and metal analyses in groundwater

PCOC	No. of wells and borings with samples analyzed	No. of wells and borings with detections	No. of detections above MCLs	MCL (mg/L)	Range of detection results above MCLs (mg/L)
antimony	42	12	8	0.006	0.008 – 0.273
antimony, dissolved	31	18	16		0.007 – 0.241
arsenic	42	16	1	0.05	0.140
arsenic, dissolved	28	4	0		NA
barium	42	42	1	2	8.97
barium, dissolved	42	42	0		NA
beryllium	42	18	2	0.004	0.010
beryllium, dissolved	31	16	0		NA
cadmium	42	8	4	0.005	0.010 – 0.019
cadmium, dissolved	32	4	1		0.014
chromium	42	36	28	0.1	0.104 – 25.1
chromium, dissolved	42	16	2		0.198 – 0.273
fluoride	42	42	1	4	8.9
fluoride, dissolved		Analyses not performed			
lead	42	18	13	0.015	0.018 – 0.69
lead, dissolved	31	13	4		0.018 – 0.058
thallium	42	3	1	0.002	0.008
thallium, dissolved	31	1	0		NA
uranium	42	18	1	0.02	0.65
uranium, dissolved	27	5	2		0.024 – 0.51

Antimony, beryllium, cadmium, and thallium appear to occur in groundwater at concentrations below MCLs, in both total and dissolved analyses, but the data do not allow a definitive conclusion. Chromium levels are below MCLs for dissolved analyses but above MCLs for total analyses. The data are insufficient to assess lead in ground water levels relative to water quality standards. This database shows that discrete areas of elevated metals in groundwater do occur. The vicinity of well MW182 is a notable example.

2.2.3.3 Radionuclide Contaminants

The investigation area database of radionuclide activity in groundwater contains analyses representing the following:

- 5 UCRS wells and 5 UCRS piezometers,
- 36 RGA monitoring wells and 1 residential well (assumed to be an RGA completion),
- 1 McNairy well, and
- Rubble Zone wells.

In addition, the investigation area includes 14 soil borings with radionuclide-in-groundwater analyses representing the UCRS (15 samples from 5 borings), the RGA (182 samples from 12 borings), and the McNairy (36 samples from 10 borings). Note that the three Rubble Zone wells sample groundwater far below the depth of interest for this investigation and will not be considered further.

The analyses of the investigation area best characterize alpha, beta, and ^{99}Tc activities, which are represented by analyses for 56 common wells and soil borings. Locations for radon-222 and uranium isotope analyses are far less populous in the investigation area. In this assessment, the range of radionuclide levels is compared to MCLs [an Administrative Consent Order (ACO) criteria is used for beta activity] to identify contaminants in groundwater of the investigation area. Table 2.8 lists the MCLs/ACO criteria and summary information on the historical radionuclide analyses available for the study area. Figures 2.7, 2.8, and 2.9 show ^{99}Tc activities in the upper, middle, and lower portions of the RGA within the study area.

Table 2.8. Summary of historical radionuclide analyses in groundwater

PCOC	No. of wells and borings with samples analyzed	No. of wells and borings with detections	No. of detections above MCLs[a]	MCL[a] (pCi/L)	Range of detection results equal or above MCLs[a] (pCi/L)
alpha activity	56	54	13	15	15.3 – 348.5
beta activity[a]	56	56	29[a]	50[a]	50.9 – 1338.3[a]
radon-222	12	12	9	300	300 – 697
technetium-99	62	60	2	900	930 – 1550
uranium-234	14	12	NA	NA	NA
uranium-235	15	7	NA	NA	NA
uranium-238	14	12	NA	NA	NA

[a]Since no convenient MCL value is available for beta activity, the ACO criteria is used for comparison.

All of the radionuclide analyses with water quality criteria identified for assessment for the C-746 S&T Landfills investigation have been detected in at least one well or soil boring at levels in excess of the criteria. However, in most cases, these exceedances are singular events that are not representative of water quality. The analyses of well MW182 are a notable exception.

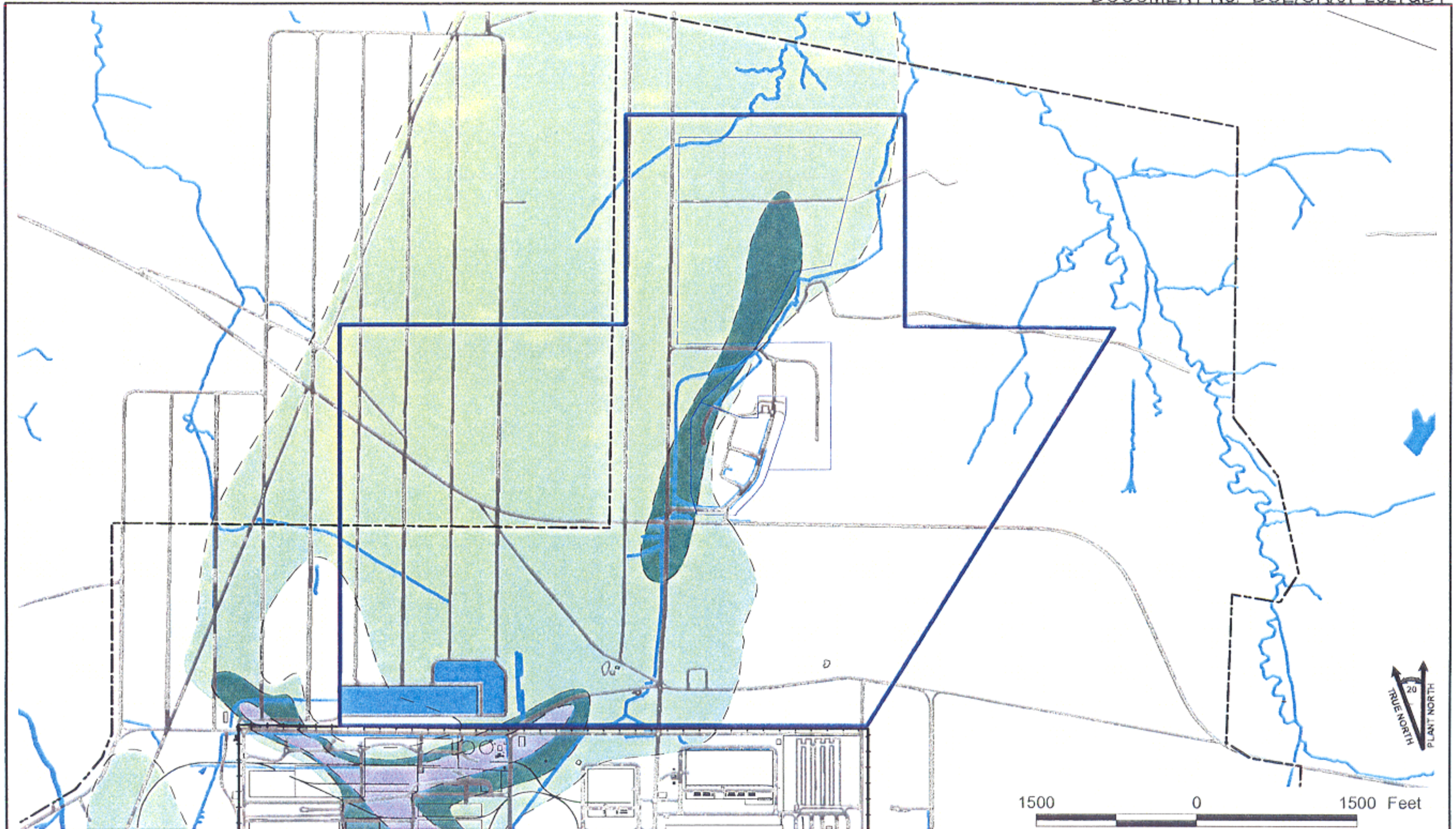
Alpha activity is below MCL levels in the investigation area with the exception of the vicinity of well MW182 and along the PGDP security fence line. Detection limits are sufficiently low such that the analyses appear to be definitive. The existing groundwater analyses for the investigation area show that beta levels are typically less than or equal to the MCL in groundwater. Among the scant analyses that did not report measurable beta activity, the level of detection is generally less than 10 pCi/L. The database is sufficient to document that beta activity does not occur at elevated activity in groundwater except in discrete areas such as the vicinity of MW182. Groundwater data for the investigation area shows that overall ^{99}Tc activity of the area groundwater is generally less than the MCL of 900 pCi/L, but are insufficient to dismiss the presence of discrete plumes originating from sources within the investigation area.

There are only a limited number of wells in the investigation area with radon-222 and isotopic uranium analyses. The available radon-222 analyses are inadequate to assess area contaminant levels in groundwater; however, the data are adequate to demonstrate that radon-222 activity frequently exceeds its MCL. With the exception of UCRS MW182, the uranium isotopes generally are present at levels of 10 pCi/L or less. The data suggest that uranium levels in groundwater are not a problem in the C-746-S&T Landfills area, except in discrete areas such as the vicinity of MW182; however, the data are insufficient to demonstrate groundwater levels across the investigation area.

3. CONCEPTUAL MODEL OF RELEASE

3.1 GEOLOGY/HYDROGEOLOGY

The subsurface at the PGDP site consists of approximately 350 ft of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. In the Jackson Purchase Region, these sediments dip gently to the south-southwest toward the axis of the Mississippi Embayment and overlie northward-dipping Paleozoic bedrock. The general stratigraphic sequence at PGDP, from oldest to youngest, is as follows: Paleozoic bedrock overlain by a rubble zone, the Cretaceous McNairy Formation,



LEGEND

- DOE BOUNDARY
- ROAD
- STREAM
- LANDFILL BOUNDARY
- C-746-S&-T RI SCOPING AREA
- ISOCONCENTRATION BOUNDARY (INTERPRETED)

Tc-99 ACTIVITIES (pCi/L)

- >3,790
- 900 - 3,790
- 100 - 900
- 25 - 100

Fig. 2.7. Technetium-99 in the upper RGA for 2001.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

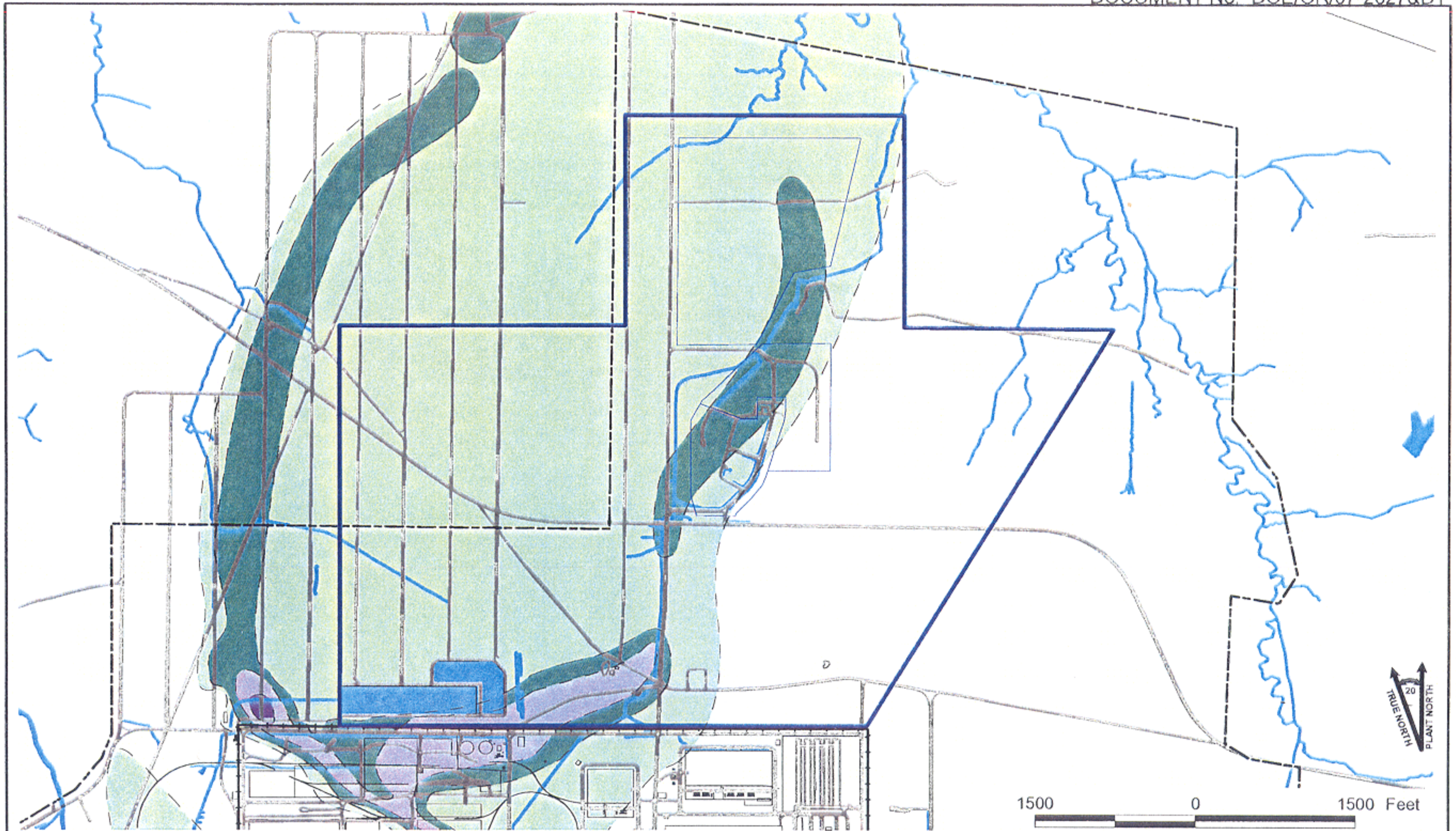
SAIC

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. c5ac90001sk458.apr
DATE 04-24-02

35

DOCUMENT No. DOE/OR/07-2027&D1



LEGEND

DOE BOUNDARY
ROAD
STREAM
LANDFILL BOUNDARY
C-746-S&-T RI SCOPING AREA
ISOCONCENTRATION BOUNDARY (INTERPRETED)

Tc-99 ACTIVITIES (pCi/L)

>3,790
900 - 3,790
100 - 900
25 - 100

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC

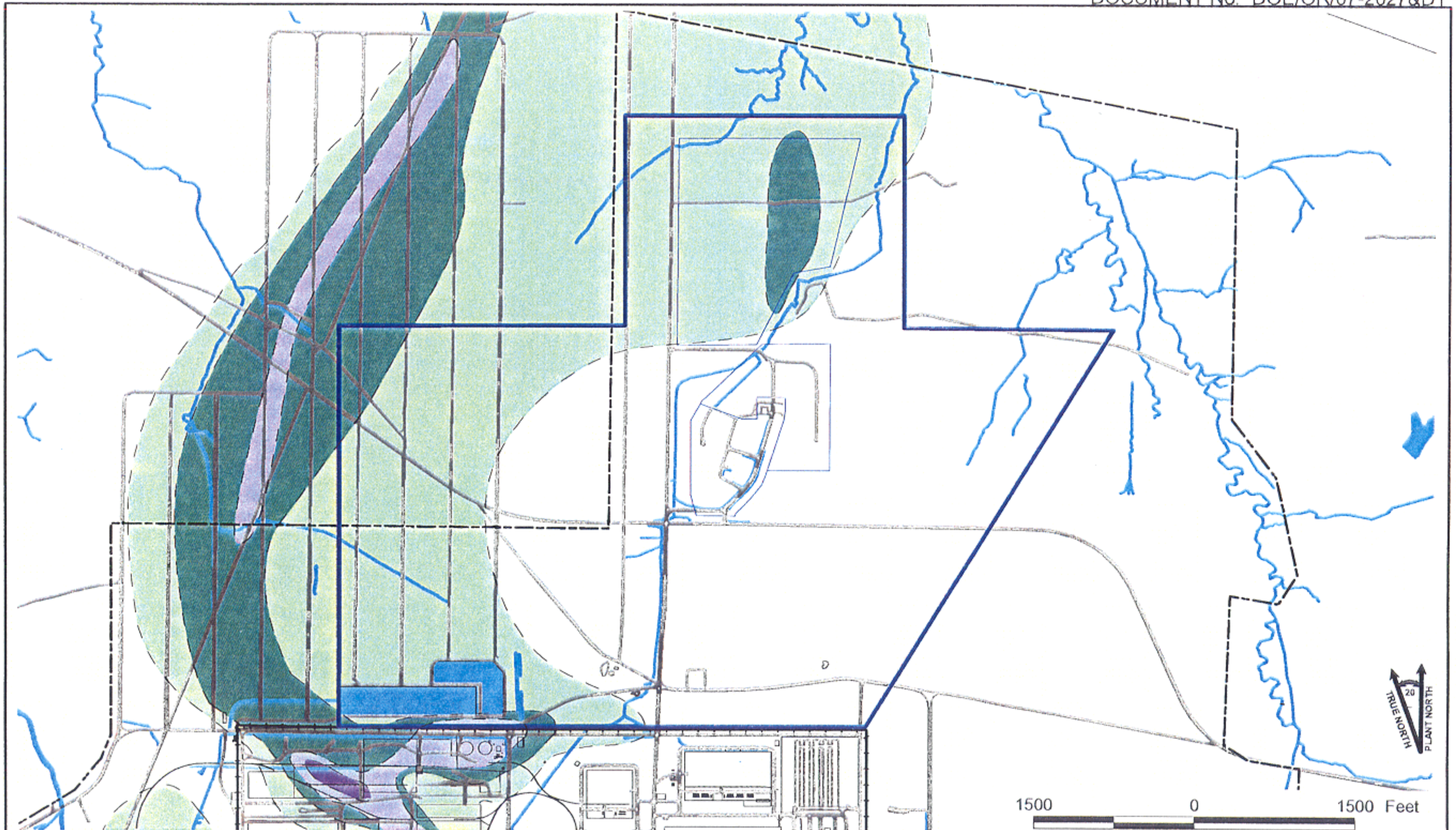
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.8. Technetium-99 in the middle RGA for 2001.

FIGURE No. c5ac90001sk459.apr
DATE 04-24-02

36

DOCUMENT No. DOE/OR/07-2027&D1



LEGEND

DOE BOUNDARY
ROAD
STREAM
LANDFILL BOUNDARY
C-746-S&-T RI SCOPING AREA
ISOCONCENTRATION BOUNDARY (INTERPRETED)

Tc-99 ACTIVITIES (pCi/L)

>3,790
900 - 3,790
100 - 900
25 - 100

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 2.9. Technetium-99 in the lower RGA for 2001.

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

FIGURE No. c5ac90001sk460.apr
DATE 04-24-02

37

the Paleocene Porters Creek Clay, undifferentiated Eocene sediments, and Pliocene and Pleistocene continental deposits. At the C-746-S&T area, however, little-to-no Porters Creek Clay is present.

Pliocene and Pleistocene continental deposits unconformably overlie the Cretaceous through Eocene strata in the vicinity of the PGDP. Beginning under the south end of the PGDP and extending north beyond the Ohio River, a thick sequence of Pliocene and Pleistocene continental deposits fills the buried valley of the ancestral Tennessee River. This sediment package consists of a basal sand and gravel member [the Lower Continental Deposits (LCD)] and an overlying finer-textured lithofacies [the Upper Continental Deposits (UCD)]. Where fully developed, the UCDs include a bottom sand unit overlaid by a thick silt and clay interval containing at least two horizons of sand and gravel.

Silt of the Pleistocene Peorian Loess and an older unit, tentatively identified as the Roxanna Loess, overlies sediments both north and south of the buried terrace slope (DOE 2001a). The loess deposit virtually is indistinguishable from silt facies of the UCD. Loess typically is 10 to 15 ft thick beneath most of the PGDP; however, construction activities have excavated the loess or replaced the loess with fill material in many areas. Soils of the area are predominantly silt loams that are poorly drained, acidic, and have little organic content.

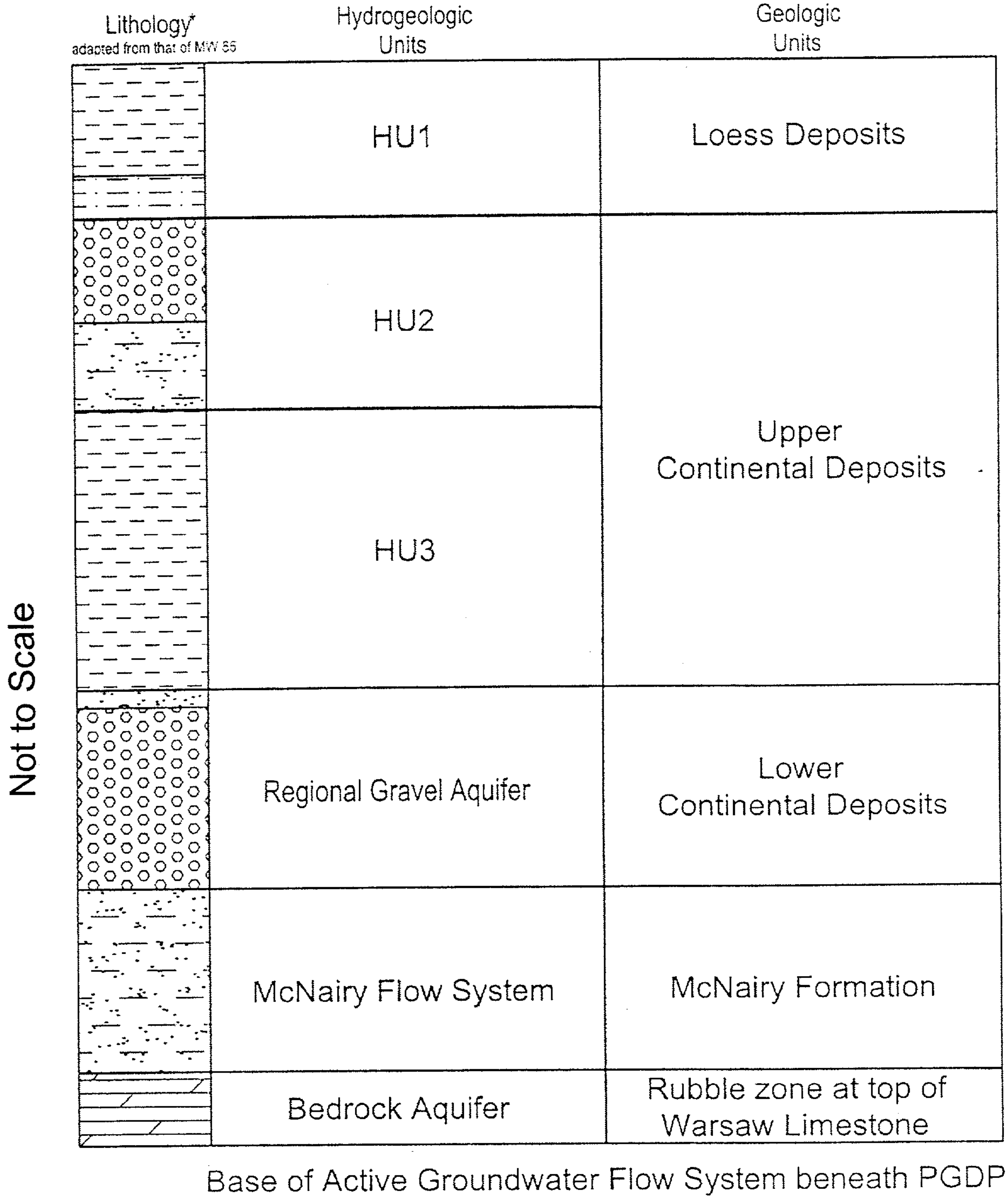
The regional groundwater flow system in the vicinity of the PGDP occurs within the Mississippian Bedrock, Cretaceous McNairy Formation, Eocene Sands, Pliocene Terrace Gravel, and Pleistocene LCD and UCD (shown in Fig. 3.1). Terms used to describe the hydrogeologic flow system are the McNairy Flow System, Eocene Sands, Pliocene Terrace Gravel, the RGA, and the UCRS. The study outlined in this scoping document focuses on the RGA and UCRS. These components of the flow system are defined below.

The RGA consists primarily of the coarse sand and gravel facies of the LCD. Permeable sands of the UCD and the McNairy Formation, where they occur adjacent to the LCD are included in the RGA. The RGA is found throughout the plant area and to the north, but pinches out to the south, southeast, and southwest along the slope of the Porters Creek Terrace. Regionally, the RGA includes the Holocene-aged alluvium found adjacent to the Ohio River.

The RGA is the shallowest aquifer beneath PGDP and is the dominant aquifer within the local groundwater flow system. Regional groundwater flow within the RGA trends north–northeast toward base level, represented by the Ohio River; however, localized groundwater mounding has been identified in quarterly C-746-S&T Landfill reports and in Fig. 3.2, derived from the 2001 annual plume map revision (BJC 2002).

The cores of the Northeast and Northwest Plumes, found to the east and west of the investigation area, are believed to delineate high-hydraulic-conductivity channels within the RGA and, therefore, represent the principal avenues for groundwater flow and contaminant transport to the north. Measured hydraulic conductivity values of the Northeast and Northwest Plumes range from 1,000 to 5,700 ft/d (Terran 1990 and CH2M Hill 1992). The average hydraulic conductivity value for the RGA outside of the main plumes is on the order of 100 ft/d (Terran 1992, LMES 1996, and BJC 1997).

Differences in permeability and aquifer thickness affect the hydraulic gradient. Low gradients in the north-central portion of the plant site are the result of a thick section of the RGA containing higher fractions of coarse sand and gravel. Northward, near the Ohio River, the hydraulic gradient increases as a result either of a thinner section of RGA or of low-permeability bottom sediments in the Ohio River.



U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.1. Hydrogeologic units.

FIGURE No. C5AC90001SK096.ppt
DATE 04-23-02

DOCUMENT No. DOE/OR/07-2027&D1

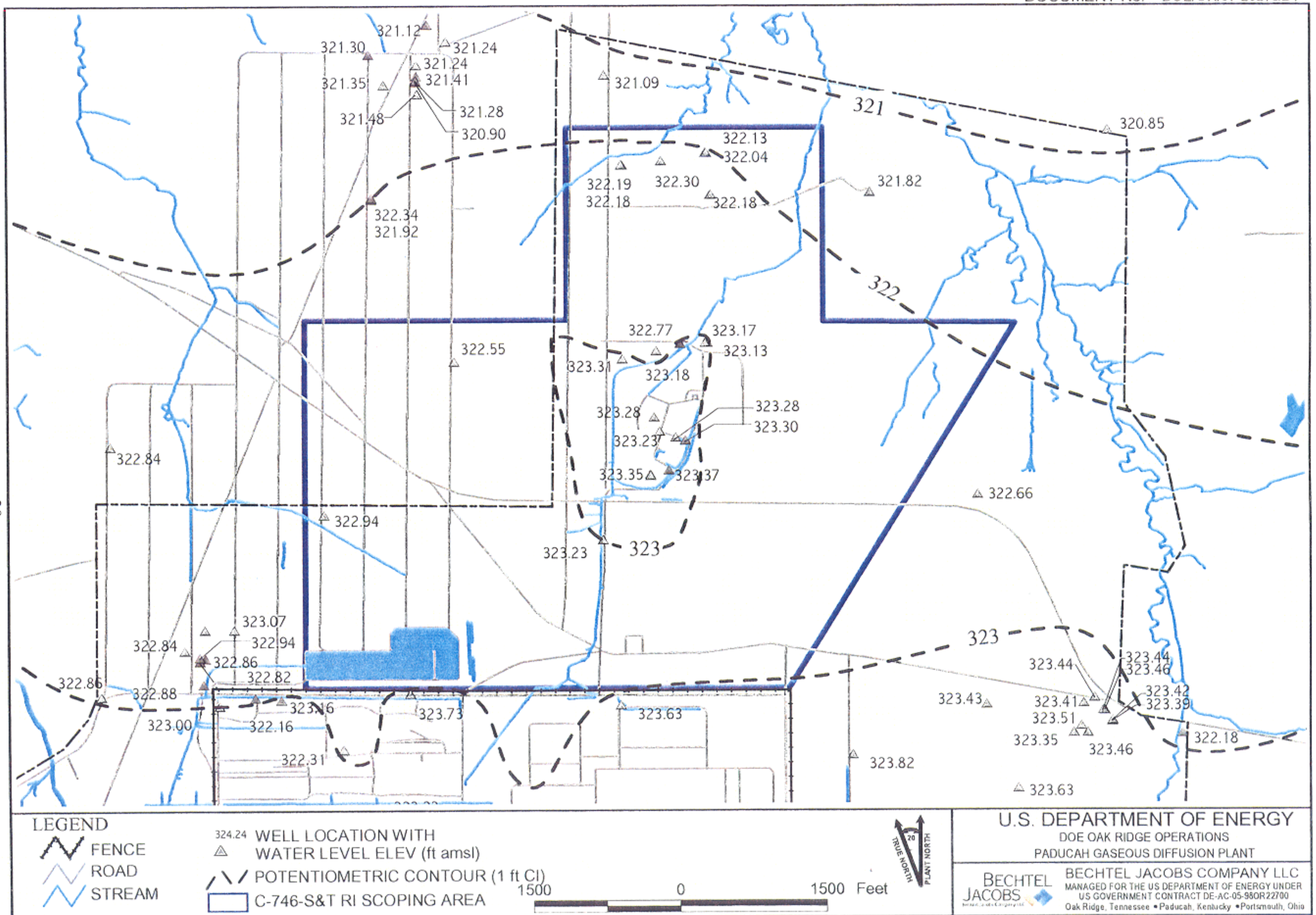


Fig. 3.2. Potentiometric surface of the RGA at the C-746-S&T RI scoping area, 3rd quarter, 2001.

FIGURE No. c5ac90001sk097r2.apr
DATE 07-08-02

The UCRS consists of a thick surface loess unit and the UCD. Hydrogeologists at the PGDP have differentiated the UCRS into three general horizons, which are as follows:

- Hydrologic Unit (HU) 1—an upper silt and clay interval (the surface loess unit);
- HU 2—an intervening interval of common sand and gravel lenses; and
- HU 3—a lower silt and clay interval.

Groundwater flow in the UCRS is predominately downward into the RGA, hence the term "recharge system." Vertical hydraulic gradients generally range from 0.5 to 1 m/m where measured in wells completed at varying depths within the UCRS. A strong hydraulic conductivity contrast exists between the UCRS, with an average conductivity value between 3×10^{-3} and 3×10^{-1} ft/d (BJC 2001), and the RGA, with an average hydraulic conductivity value of approximately 100 ft/d.

Identification of the source of the groundwater contaminants present in the area of the C-746-S&T Landfills is a primary goal of this RI. Previous conceptual models for the groundwater contaminants in the area have suggested that the C-746-S&T Landfills and the NSDD were the sources for these contaminants.

3.2 POTENTIAL CONTAMINANT SOURCES

Potential contaminant sources for the C-746-S&T RI area include the following:

- C-746-S&T Landfills (SWMUs 9, 10, and 145);
- C-616 Lagoons (SWMUs 17 and 18);
- NSDD – outside of the plant security fence (SWMU 58);
- Upgradient plumes; and
- Biofouling/corrosion of wells.

3.2.1 C-746-S&T Landfills

Much of the disposal that occurred at SWMUs 10 and 145 was completed in an unlined area; therefore, any debris that contained contamination would be a possible source of groundwater contamination. In July 1999, a tar-laden material was discovered west of the C-746-S Landfill. The debris had radioactive contamination of 43,000 disintegrations per minute. Samples of the material indicated elevated levels of uranium and technetium.

Additionally, the SWMU 9 area was used as a contractors' disposal area prior to permitting of the C-746-S Landfill. The nature of waste disposed of in the SWMU 9 area prior to landfill permitting is poorly documented. Based on the types of waste generated at the PGDP prior to permitting of the C-746-S&T Landfills, TCE and ^{99}Tc are recognized as likely contaminants associated with the landfills.

3.2.2 C-616 Lagoons

Although both lagoons are lined, hydraulic potential indicates that impounded water is infiltrating to the groundwater system. Radionuclides and metals are the primary contaminants contained in the C-616-E Lagoon. The preliminary list of contaminants related to the C-616-F Sludge Lagoon, based on knowledge of historical operations and of contaminants associated with the NSDD, includes phosphate, metals, radionuclides, polychlorinated biphenyls (PCBs), and pesticides.

3.2.3 NSDD

Contaminants in the NSDD surface soils and sediments may migrate offsite via sediment transport during storm events. Currently, the NSDD is not believed to be a significant source of contaminants leaching to the subsurface soils or the groundwater. Contaminants present in the NSDD that had the potential to leach are expected already to have migrated.

The principal contaminants associated with the sediments and soils of the NSDD outside the PGDP security area are radionuclides, metals, and PCBs. A screen of NSDD soil and sediment analytical data indicated 24 metals and 8 radionuclides (Table 3.1) that are present at levels in excess of site background values (DOE 2001b).

Table 3.1. Metals and radionuclides that exceed background levels[a] in soil and sediment samples from the NSDD (outside PGDP security area)

Chemical	Background value[a]	Maximum value[b]
	Metals (mg/kg)	
antimony	0.21	17.9
arsenic	12	11
beryllium	0.67	6.5
cadmium	0.21	8.03
calcium	200,000	16,900
chromium	16	213
cobalt	14	16
copper	19	33.1
iron	28,000	47,400
lead	36	106
manganese	1,500	1,450
nickel	21	71.96
silver	2.3	37.8
thallium	0.21	25.9
uranium	4.9	200
zinc	65	69.5
	Radionuclides (pCi/g)	
cesium-137	0.49	10.9
neptunium-237	0.1	43.2
plutonium-239	0.025	240
technetium-99	2.5	3,900
thorium-230	1.5	594
uranium-234	2.5	120
uranium-235	0.14	12
uranium-238	1.2	314.1

[a]Background levels used in the comparison were those for surface soil. These values and their sources are presented in DOE 2001a.

[b]Values are found in the NSDD Off-site Binning Package presented to the Core Team in summer and fall 2000.

Based on the previous investigations and evaluations of the NSDD the following information is known:

- most contaminated soil and sediment in the NSDD is expected to occur at depths that range from the surface to 4 ft bgs, with the deepest contamination generally occurring at locations inside the PGDP security fence (portions of the NSDD located inside the PGDP security fence are not included in the study area of this scoping document);

- the areal extent of radionuclides and metals contamination outside of the PGDP security fence is expected to be intermittent and to coincide with areas of sediment deposition; and

- PCBs concentrations in excess of 1 ppm are frequently present along the northeast trending section of the NSDD north of the C-746-S&T Landfill and are present intermittently in other sections of the NSDD.

3.2.4 Upgradient Plumes

Plumes of TCE and ^{99}Tc contamination have been identified at PGDP in locations upgradient of the C-746-S&T Landfills, based on general groundwater flow direction within the RGA. This interpreted groundwater flow direction indicates that these upgradient plumes are migrating northward and could introduce contamination into the groundwater in the area of the C-746-S&T Landfills.

3.2.5 Biofouling/Corrosion of Wells

A video survey of monitoring wells surrounding the C-746-S&T Landfills and of other wells in the vicinity indicated extensive biofouling of the well screens and corrosion of the stainless steel well casing. Biofouling and corrosion of stainless steel well screens would be expected to introduce increased-levels of metals into the groundwater of an affected well and, thereby, contribute to metals contamination of the surrounding aquifer (BJC 2000).

3.3 REGIONAL GRAVEL AQUIFER CONTAMINANT PLUMES

The Northeast Plume, with TCE as the primary contaminant, and the Northwest Plume, with both ^{99}Tc and TCE as primary contaminants, bound the east and west sides, respectively, of the investigation area. An area of ^{99}Tc contamination extends northward from the area of the C-616 Lagoons through the west end of the investigation area (BJC 2002). Figures 3.3 and 3.4 present the PGDP groundwater TCE and ^{99}Tc plume maps as mapped for calendar year 2001.

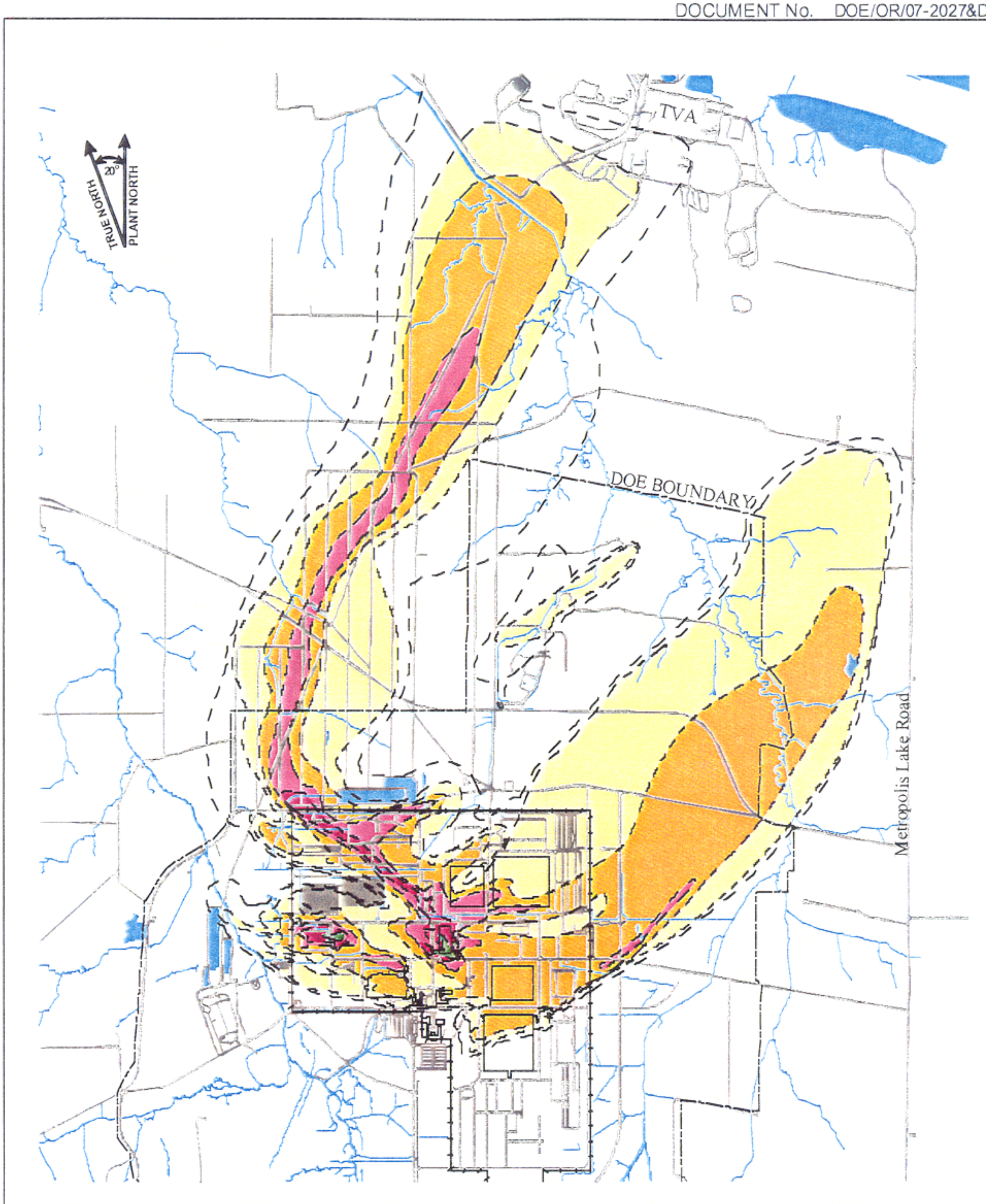
3.4 POTENTIAL RELEASE AND EXPOSURE PATHWAYS

Potential release and exposure pathways for the possible contaminant sources listed previously include release of contaminants to surface and subsurface soils, or release directly to groundwater; infiltration of contaminates through surface and subsurface soils to underlying groundwater; and contaminant transport via groundwater migration. These potential pathways are illustrated in Fig. 3.5.

3.5 POTENTIAL CONTAMINANTS OF CONCERN (SITE-RELATED CONSTITUENTS)

To determine the PCOCs expected to be present within the investigation area, data from the Paducah OREIS database were downloaded and reviewed. Data reviewed included all existing soil, sediment, and groundwater data for all sampling stations located within the boundary of the C-746-S&T RI scoping area (see Fig. 1.1). Surface water data was not included in these summaries due to the transient nature of the media.

Maps summarizing the results of the data review are included as Appendices A (soil data) and B (groundwater data) to this scoping document. Chemical-specific maps depicting groundwater sample locations in which the specific chemical exceeded a MCL or other specified standard (50 pCi/L for beta activity, 0.015 mg/L for lead, any detection of organics, or any detection of radionuclides) are presented. In addition, chemical-specific maps identifying soil detections of the chemicals present in groundwater are included.



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED)

3000 0 3000 Ft

TCE CONCENTRATIONS (ug/L)

- >100,000
- 10,000 - 100,000
- 1,000 - 10,000
- 100 - 1,000
- 5 - 100
- 1 - 5

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

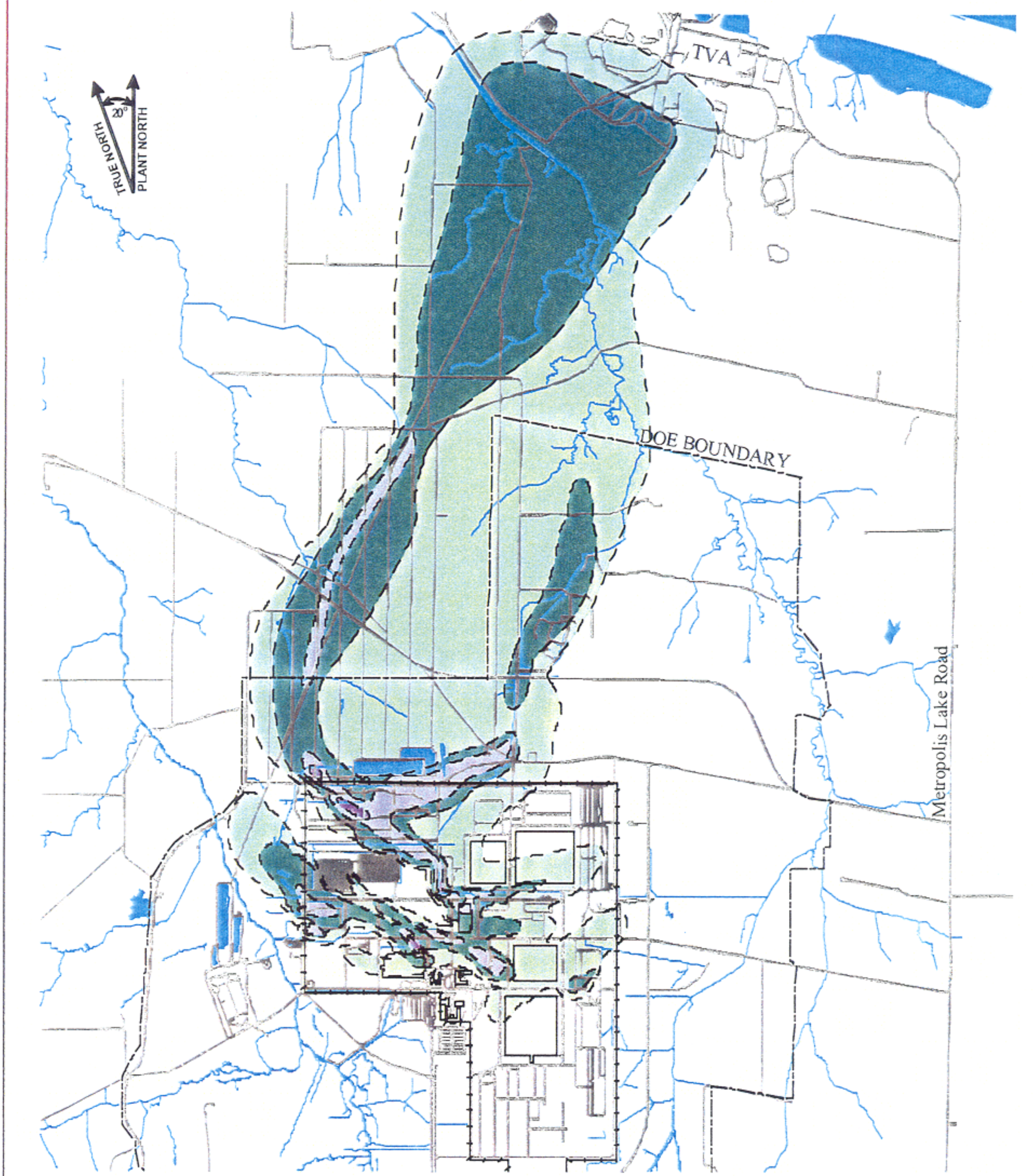
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee• Paducah, Kentucky Portsmouth, Ohio

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.3. Trichloroethene plume in the RGA for 2001.

FIGURE No. c5ac90001sk379r2.apr
DATE 07-08-02



LEGEND:

ISOCONCENTRATION BOUNDARY (INTERPRETED)

3000 0 3000 Ft

Tc-99 ACTIVITIES (pCi/L)

- >3,790
- 900 - 3,790
- 100 - 900
- 25 - 100

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS

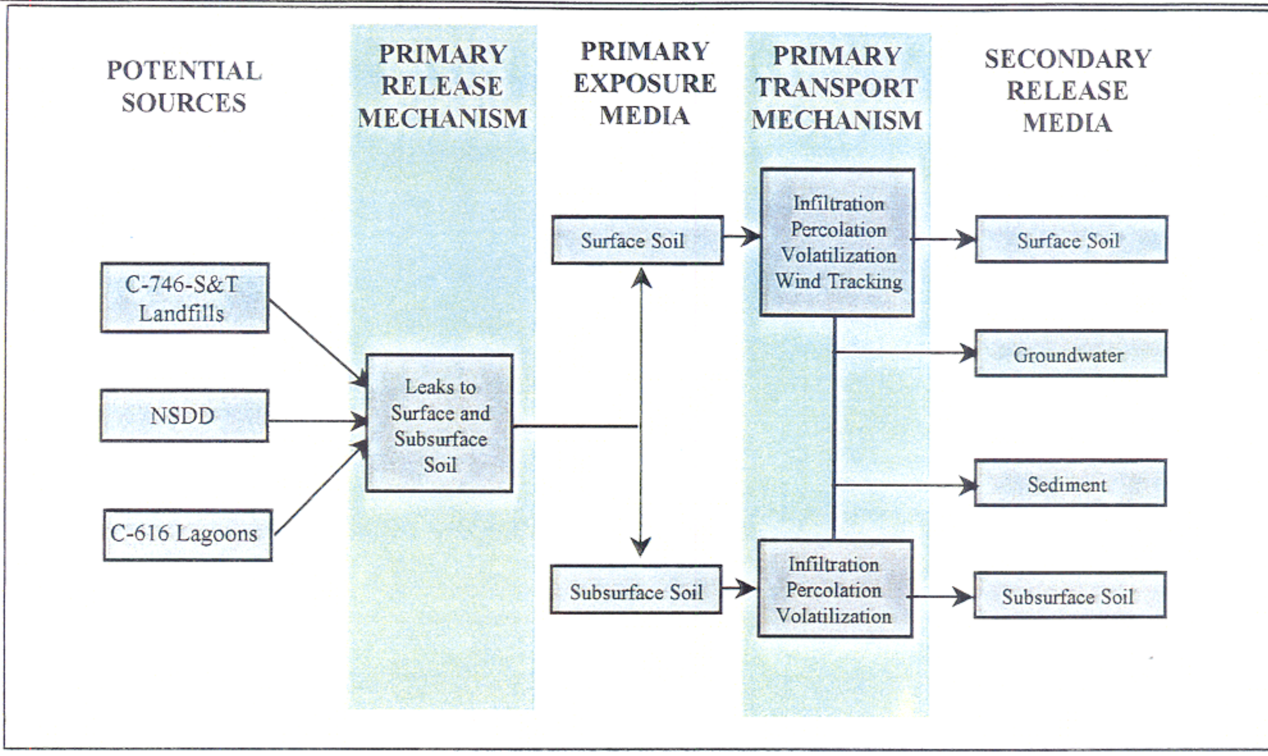
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky Portsmouth, Ohio

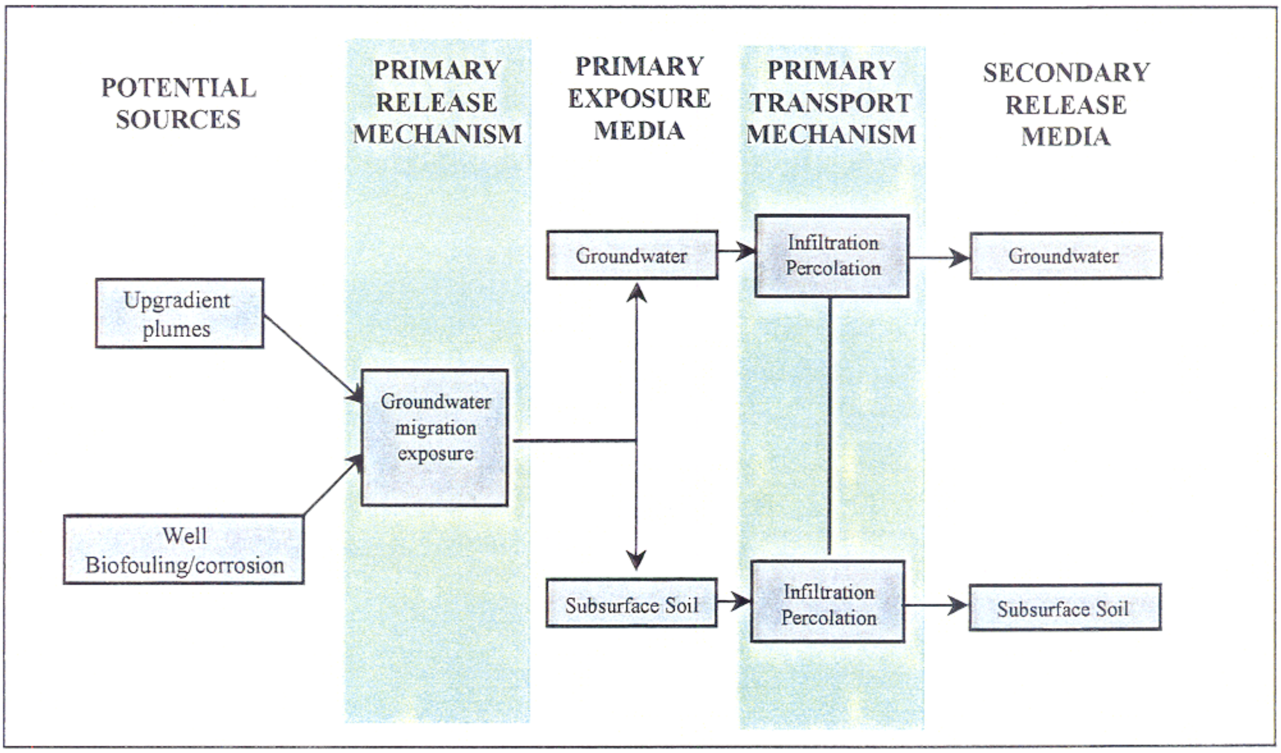
SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.4. Technetium-99 plume in the RGA for 2001.

FIGURE No. c5ac90001sk381r3.apr
DATE 07-08-02





U. S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.5. Potential release and exposure pathways for C-746-S&T RI scoping area.

FIGURE No. C5AC90001SK094.ppt
DATE 08-12-01

The following analytes were detected in groundwater from the C-746-S&T Landfills RI scoping area and exceeded the MCL or other specified standard in more than 10% of the groundwater samples analyzed for that particular analyte.

- **Metals and Inorganics:** fluoride, antimony, dissolved antimony, arsenic, barium, beryllium, cadmium, dissolved cadmium, chromium, lead, dissolved lead, thallium, uranium, and dissolved uranium.

- **Radionuclides:** alpha activity, beta activity, radon-222, and ^{99}Tc.

- **VOCs:** 1,1-DCE and TCE.

In a November 2001 meeting of the GWOU PCT, the PCOCs for the C-746-S&T Landfills RI/FS were reviewed and a joint decision was made by the GWOU PCT that the following contaminants could be excluded from consideration as PCOCs:

- dioxins,
- polyaromatic hydrocarbons (PAHs),
- pesticides, and
- PCBs.

Based on their review, the GWOU PCT further agreed that the following analytes should be designated as PCOCs for the RI/FS:

- metals (including an emphasis on arsenic and chromium),
- radionuclides (including an emphasis on ^{99}Tc), and
- VOCs (including an emphasis on TCE and its degradation products).

4. RESPONSE SCENARIOS

4.1 LIKELY RESPONSE SCENARIOS THAT ARE POTENTIALLY APPLICABLE

General response actions are media-specific actions that will satisfy the remedial action objectives (RAOs). Contaminated soils and ground water that warrant remedial action within the scope of the C-746-S&T project may be grouped according to contaminants (e.g., VOCs, semivolatile organic compounds, metals, radionuclides) and other mitigating factors (i.e., depth, saturation, physical restrictions/infrastructure, etc.). The following general response actions then will be considered for soil and debris: treatment (*in situ* and/or *ex situ*), containment, excavation, disposal, institutional actions, and combinations of these actions. For groundwater, the following general response actions then will be considered: treatment (*in situ* and/or *ex situ*), containment, institutional actions, and combinations of these actions. Following the RI, an appropriate range of remedial or removal alternatives will be developed, as required by the NCP (40 *CFR* 300).

4.2 APPLICABILITY OF PRESUMPTIVE REMEDIES AND INNOVATIVE TECHNOLOGIES

Presumptive remedies, which are developed by the U.S. Environmental Protection Agency (EPA), are established technologies for common categories of sites based on scientific studies and historical data obtained at Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) sites across the nation. Presumptive remedies may save time and money by accelerating and focusing the RI/FS process, and they help promote consistency and predictability of the remedy selection process. EPA guidance indicates that presumptive remedies are expected to be used at all appropriate sites. EPA has published two sets of guidance that are potentially applicable to the C-746-S&T project: (1) presumptive remedies for VOCs in soil and (2) presumptive remedies for metals in soils. The EPA directive entitled *Presumptive Remedies: Site Characterization and Technology Selection For CERCLA Sites With Volatile Organic Compounds In Soils,* EPA 540-F-93-048, identifies soil vapor extraction, thermal desorption, and incineration as the presumptive remedies for Superfund sites with VOC-contaminated soil. The EPA directive entitled *Presumptive Remedy for Metals-in-Soil Sites,* EPA 540-F-98-054, identifies reclamation/recovery and immobilization as the presumptive remedies for contaminated soils identified as principal threat wastes; and it identifies containment as the presumptive remedy for contaminated soils identified as low-level threat wastes. There is, however, insufficient data associated with the C-746-S&T Landfill project to initiate a presumptive remedy. Data needs are outlined in Chap. 5 of this document.

5. SCOPING DATA NEEDS

This scoping document uses the DQO process to identify environmental problems and to define data collection processes needed to support decisions regarding these problems. The GWOU PCT met in November and December 2001 to start the DQO process for the C-746-S&T Landfills RI/FS. Based on their review of the available data, the GWOU PCT agreed to the following conclusions and recommendations for the collection of additional data at the potential contaminant sources included in the C-746-S&T Landfill study area. The GWOU PCT further agreed that all transect and data point locations suggested below are approximate and recommends that the project team evaluate existing data and adjust proposed sampling locations as appropriate during final scoping activities.

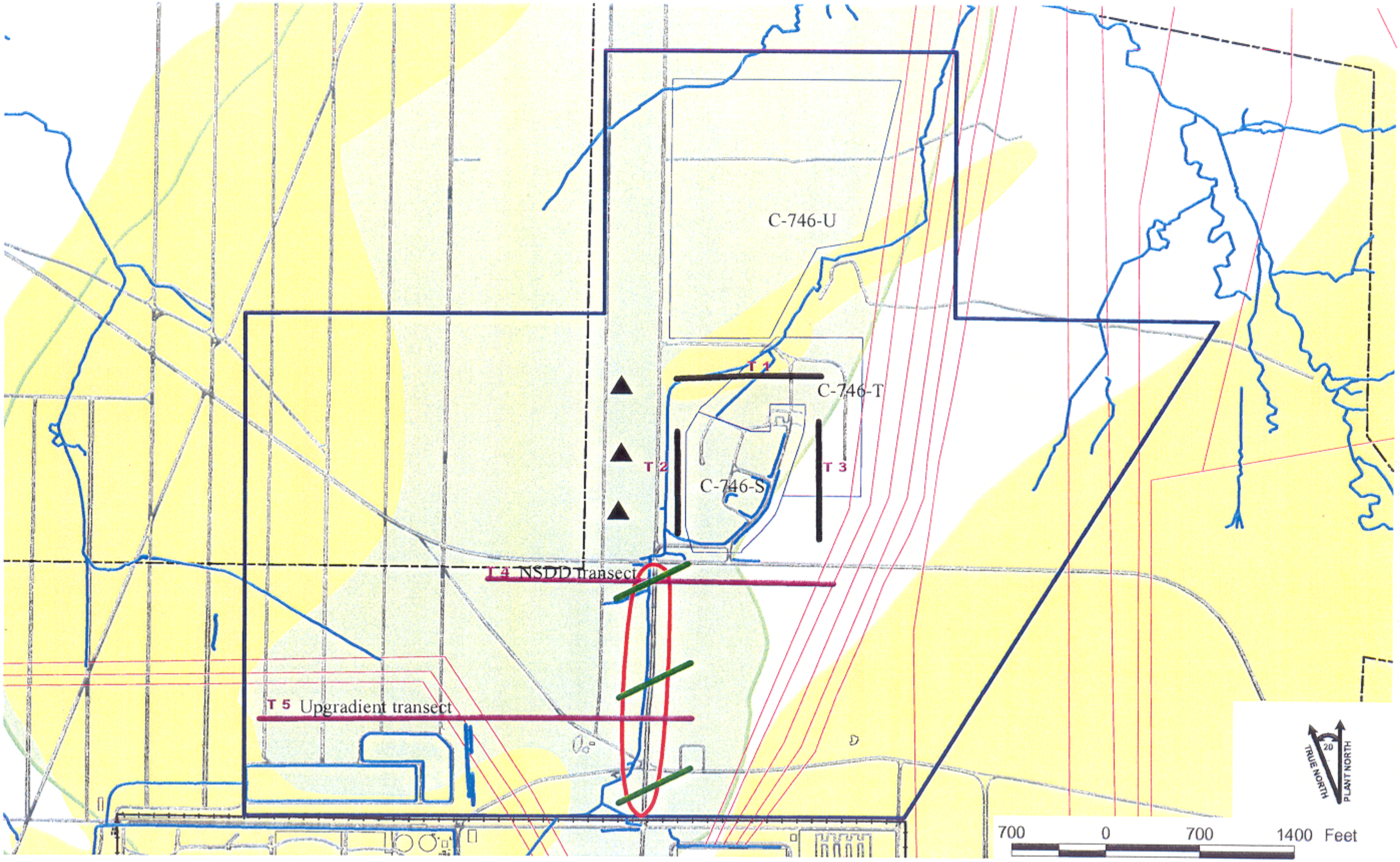
5.1 C-746-S&T LANDFILLS

The GWOU PCT agreed to the following conclusions concerning the C-746-S&T Landfills.

- The abandoned portion of the NSDD is the landfill boundary.
- The heterogeneous nature of the C-746-S&T Landfill complex and its size (approximately 20 acres) is too great to use angle drilling to collect subsurface samples. It was determined that data collected from angular bores in the area of the C-746-S&T Landfills would not provide any meaningful information.
- The UCRS cannot be considered an integrator of contamination in this area because flow within the UCRS is predominantly vertical; therefore, collection of UCRS samples at the C-746-S&T Landfills would not be useful.
- It may be difficult to differentiate the C-746-S&T Landfills from other sources of contamination the area (i.e., P Landfill, the abandoned portion of NSDD, etc).

The GWOU PCT recommends that the following additional soil and groundwater data be collected from the C-746-S&T Landfills during the RI activities.

- Additional analytical data from the C-746-S&T Landfills should be obtained along three transects (lines of temporary borings) around the landfills complex (Fig. 5.1).
- Data also should be collected from a fourth transect running west to east above the NSDD Section 3. These additional samples would provide the data necessary to determine if the C-746-S&T Landfills are leaking.



LEGEND
FENCE
ROAD
STREAM
DOE BOUNDAY
LANDFILL BOUNDARY
C-746-S&-T RI SCOPING AREA
OVERHEAD ELECTRICAL LINES
TCE PLUME BOUNDARY
TC99 PLUME BOUNDARY
NSDD AREA
NSDD TRANSECT
S&T TRANSECT
ADDITIONAL DATA POINT FOR PLUME DEFINITION

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 5.1. Transects for data gathering within the C-746-S&T RI scoping area.

FIGURE No. c5ac90001sk395apr
DATE 04-23-02

49

5.2 C-616 LAGOONS

The GWOU PCT agreed to the following assumptions concerning the C-616 Lagoons.

- The primary PCOCs are ^{99}Tc and metals, mainly arsenic and chromium. Process history indicates that TCE is not an expected PCOC at the lagoons.
- The area occupied by the lagoons is small enough to assume that, if the lagoons are leaking, they will be leaking across the entire lagoon area.
- It was further agreed that sampling at any point beneath the lagoon would be sufficient to detect an increase in contamination resulting from a leak, regardless of the exact location of the leak.

The GWOU PCT recommends that the following additional data be collected from the C-616 Lagoons during the RI activities.

- Two to three angle borings around the perimeter of the C-616 Lagoons would be sufficient to determine if the lagoons are a source of groundwater contamination. These angle borings should terminate in the upper RGA, in order to gain one groundwater sample from the RGA.
- The project team will propose locations for the angular bores.
- An unsaturated soil sample should be collected from each angle boring.
- Samples should be taken from a depth of 28 ft bgs down to the RGA.
- Angular borings are anticipated to extend approximately 20 ft horizontally from the edge of the lagoon toward the center.

5.3 NSDD

The GWOU PCT agreed to the following conclusions concerning that portion of the NSDD addressed by the C-746-S&T Landfill RI/FS.

- The primary PCOCs are VOCs, ^{99}Tc, and metals, mainly arsenic and chromium.
- Both angle drilling and vertical drilling should be used to obtain additional samples from the NSDD. The purpose of the angle borings is to determine if there is any evidence of a release below the NSDD. These angle borings should terminate in the upper RGA, in order to gain one groundwater sample from the RGA. The purpose of the vertical bores is to confirm the boundary of any potential contamination and of the ditch.

The GWOU PCT recommends that the following additional data be collected from the NSDD during the RI activities.

- Soil and groundwater samples should be collected from transects across the NSDD. Approximate locations of these transects are depicted on Fig. 5.1.
- Due to the nature of the ditch the GWOU PCT agreed that samples should be collected from both angular boreholes and vertical boreholes located along the banks of the NSDD. The use of angle

drilling to obtain samples from areas beneath the ditch would reduce the likelihood of samples becoming contaminated by water that could be present in the NSDD.

Soil samples are to be collected from the top of HU2, from the top of HU3, and from 4 ft below the top of the HU3 in both angle and vertical borehole (Fig. 5.2).

- A sample of first water encountered in each borehole will be collected, but no water samples will be collected deeper than 4 ft below the top of the HU3.
- Stratified samples will be taken along the vertical transect to provide a better understanding of the lower and upper RGA.

5.4 UPGRADIENT PLUMES

The GWOU PCT recommends that the following additional data be collected during the C-746-S&T Landfills RI to determine if TCE and ^{99}Tc plumes upgradient of the landfills complex are contributing to groundwater contamination at the landfill.

- Samples should be collected along two east to west transects. T4 is north of NSDD Section 3 and T5 is north of the C-616 Lagoon (which also cuts across the NSDD) (Fig. 5.1). This data will help define whether there is one continuous plume extending north from the area of the C-616 Lagoons and reduce data gaps.
- Two sampling points/wells (Fig. 5.1) should be added west of the C-746-S&T Landfills to determine if the groundwater plume in that area is moving toward the Landfill. DOE should incorporate the installation of these wells with the well replacement effort for the C-746-U and C-746-S&T Landfills.

6. DATA QUALITY OBJECTIVES

The DQO process is a planning tool used to develop sampling designs for data collection activities that support decision-making. DQOs use systematic planning that enables the planning team to clearly separate and delineate data requirements for each problem/decision. The DQO Process can be used repeatedly throughout the life cycle of a project, as illustrated in Fig. 6.1.

A summary of the seven steps of the DQO planning approach is presented below.

Step 1 – State the Problem. Step 1 describes the problem to be addressed and develops a conceptual model of the environmental hazards to be investigated; designates members of the planning team (including the decision makers); and identifies available resources, constraints, and deadlines.

Step 2 – Identify the Decision. Step 2 identifies the principal study question; defines the alternative actions and combines the principal study question and alternative actions into a decision statement, which may be based on regulatory guidelines; states whether or not action will be taken on each decision; and organizes multiple decision statements into an order of priority.

Step 3 – Identify the Inputs to the Decision. Step 3 identifies the types of information needed to perform the RI and source(s) of that information; determines the basis for setting an Action Level; and confirms the appropriateness of proposed sampling and analysis methods.